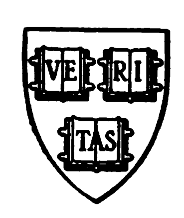
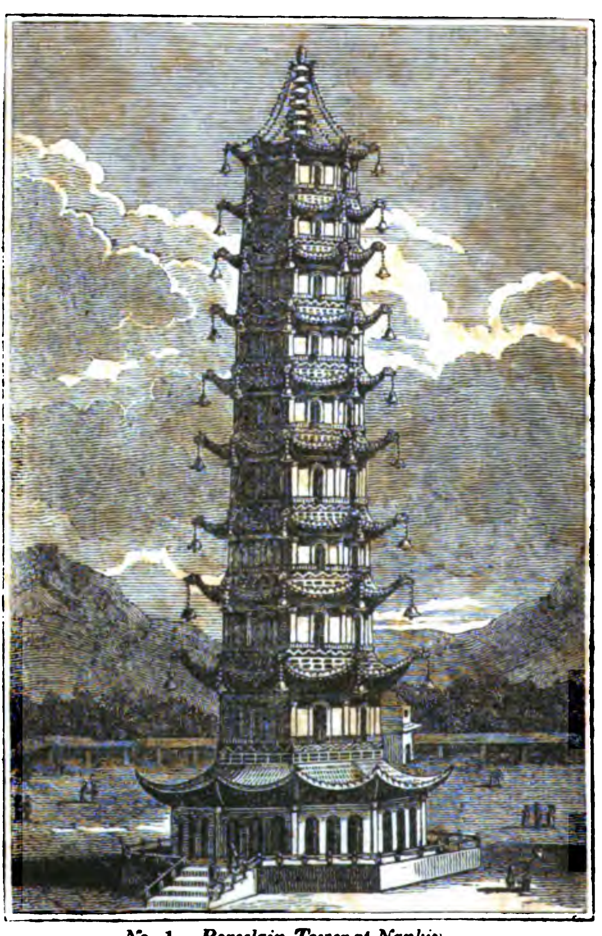

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No. 1.—*Porcelain Tower at Nankin.*

THE HUNDRED WONDERS OF THE WORLD,

AND OF THE THREE

KINGDOMS OF NATURE,

DESCRIBED ACCORDING TO THE

LATEST AND BEST AUTHORITIES,

AND ILLUSTRATED

BY ENGRAVINGS.

BY THE REV. C. C. CLARKE.

"The Ancients boasted of their *Seven Wonders* of the *World;* but this Work will prove that the Moderns may boast of their *Hundred Wonders.*
PREFACE.

FIRST AMERICAN,
FROM THE TENTH LONDON EDITION.

NEW-HAVEN:
PRINTED FOR JOHN BABCOCK AND SON,
AND S. AND W. R. BABCOCK,
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SIDNEY'S PRESS.—1821.

PREFACE.

The Ancients boasted of their Seven Wonders of the World, but this work will prove that the Moderns may boast of their Hundred Wonders.

To *embody* these wonders, whether of nature, or of art, and to bring them into a comprehensive form, from the different stores in which they may be said to have been hitherto locked up, has been the aim of the editor of these pages. They are here drawn into light, and exhibited at a single view, presenting whatever is most striking in the creation, and whatever the genius and in-

dustry of man have been able to effect, in order to excite admiration at the sublimity of his conceptions, the depth of his scientific researches, and the grandeur of those structures, many of which have subsisted, almost unimpaired, for a long succession of ages, in testimony of his consummate skill, which could thus achieve monuments, at once so splendid, and of so imperishable a nature!

Those marvellous relations which the mischievous fancy of travellers has too often imposed on the credulity of the weak, as well as the fables founded in bigotry, which were received as truths in the dark ages, have been sedulously shunned: where the subjects treated have incidentally led to them, they have, on the other hand, been as carefully ex-

posed. But whatever has been confirmed by the concurrent testimony of enlightened writers, has been faithfully digested from their works. Whether on the subjects in which nature, in the different departments of her empire, and in the bestowal of her sublime gifts and attributes, displays herself in her most magnificent attire; or on those in which art has overstepped the ordinary bounds assigned to the faculties of man; the best authorities have been throughout consulted. The editor, therefore, flatters himself that, in compiling and assembling so many objects of wonder and delight, he has conferred a real benefit on the rising generation, and that his labours will not be disdained by those even, whose researches into THE SUB-

LIME WONDERS OF NATURE AND OF ART, have engrossed the chief of their attention.

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THE WONDERS OF THE WORLD,

AND OF THE

THREE KINGDOMS OF NATURE.

THE MOUNTAINS OF THE ANDES,

IN SOUTH AMERICA.

[*See Plate, No.* 2.]

"*Mountains and all hills—praise the name of the Lord; for his name alone is excellent: his glory is above earth and heaven.*"

Among the wonders, or uncommon phenomena of the *world, may be classed* stupendous Mountains; and of these the Andes, in South America, are the loftiest, the most extensive, and, therefore, the most wonderful. Description of objects which are striking, because they are vast, often fail in exciting appropriate ideas; and however accurate or poetical may be the accounts of this class of Nature's Prodigies, no just notions of their vastness can be conveyed by any written or graphical representation. The magnitude of an object must be seen to be duly conceived, and *mountain-wonders will* be best felt by those who have visited Wales, Scotland, Switzerland, or the mountaneous regions of America or Asia.

The stupendous mountains called by the Spaniards the Cordilleras, (from cord, or chain, pronounced by them *Cor-dil-le'-ras,*) or Chains of the Andes, (An'-des,) stretch north and south, near the western coast, from the Isthmus of Darien, through the whole of the continent of South America, to the Straits of Magellan. In the north there are *three* chains of separate ridges, but in advancing from *Popayan* towards the south, the three chains unite into

a single group, which is continued far beyond the equator. In the kingdom of Quito,* the more elevated summits of this group are ranged in two rows, which form a double crest to the Cordillera. The extent of the Andes Mountains is not less than four thousand three hundred miles.

> Rocks rich in gems, and mountains big with mines,
> That on the high equator ridgy rise,
> Whence many a bursting stream auriferous plays.
>
> THOMSON.

In this country the operations of nature appear to have been carried on on a large scale, and with a bolder hand, than elsewhere; and in consequence the whole is distinguished by a peculiar magnificence. Even the plain of Quito, which may be considered as the base of the Andes, is more elevated above the sea than the summits of many European mountains. In different places the Andes rise more than one third above the famous Peak of Teneriffe, the highest land in the ancient hemisphere. Their cloud-enveloped summits, though exposed to the rays of the sun in the torrid zone, are covered with eternal snows, and below them the storm is seen to burst, and the exploring traveller hears the thunder roll, and sees the lightnings dart beneath his feet.

Throughout the whole of the range of these extensive mountains, as far as they have been explored, there is a certain boundary, above which the snow never melts, which boundary, in the torrid zone, has been ascertained to be 14,600 feet, or nearly three miles, above the level of the South Sea.

The ascent to the plain of Quito, on which stands Chimborazo, Cotopaxi, Pichincha, &c. is thus described by Don Juan de Ulloa:

"The ruggedness of the road from Taraguaga, leading up the mountain, is not easily described. The declivity is so great, in some parts, that the mules can scarcely keep their footing; and, in others, the acclivity is equally difficult. The trouble of sending people before to mend the road, the pain arising from the many falls and bruises, and

* Pronounced Que-to, the *i* in all European languages being sounded as an *e*.

the being constantly wet to the skin, might be supported; but these inconveniences are augmented by the sight of such frightful precipices, and deep abysses as excite constant terror. The road, in some places, is so steep, and yet so narrow, that the mules are obliged to slide down, without making any use whatever of their feet. On one side of the rider, in this situation, rises an eminence of many hundred yards; and, on the other, is an abyss of equal depth; so that, if he should give the least check to his mule, and destroy the equilibrium, both must inevitably perish.

"Having travelled nine days in this manner, slowly winding along the sides of the mountains, we began to find the whole country covered with a hoar-frost; and a hut, in which we reposed, had ice in it. At length, after a perilous journey of fifteen days, we arrived upon a plain, at the extremity of which stands the city of Quito, the capital of one of the most charming regions in the world. Here, in the centre of the torrid zone, the heat is not only very tolerable, but, in some places, the cold is even painful. Here the inhabitants enjoy the temperature and advantages of perpetual spring; the fields being constantly covered with verdure, and enamelled with flowers of the most lively colours. However, although this beautiful region is more elevated than any other country in the world, and it employs so many days of painful journey in the ascent, it is itself overlooked by tremendous mountains; their sides being covered with snow, while their summits are flaming with volcanoes. These mountains seem piled one upon the other, and to rise with great boldness to an astonishing height. However, at a determined point above the surface of the sea, the congelation is found at the same height in all the mountains. Those parts which are not subject to a continual frost, have here and there growing upon them a species of rush, resembling the broom, but much softer and more flexible. Towards the extremity of the part where the rush grows, and the cold begins to increase, is found a vegetable with a round bulbous head. Higher still, the earth is bare of vegetation, and seems covered with eternal snow. The most remarkable of the Andes are the mountains of Chimborazo, Cotopaxi, and Pichincha."

CHIMBORAZO,

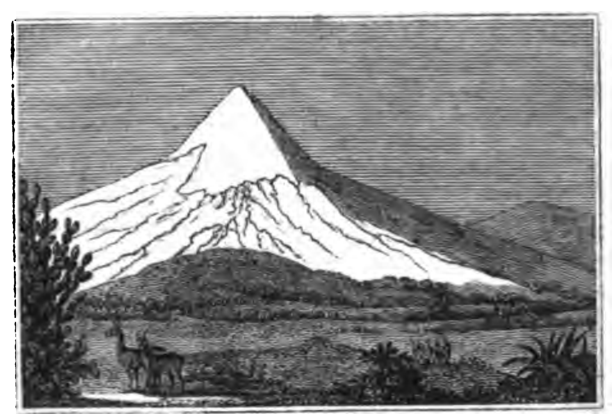
THE MOST LOFTY OF THE ANDES.

[*See Plate, No.* 4.]

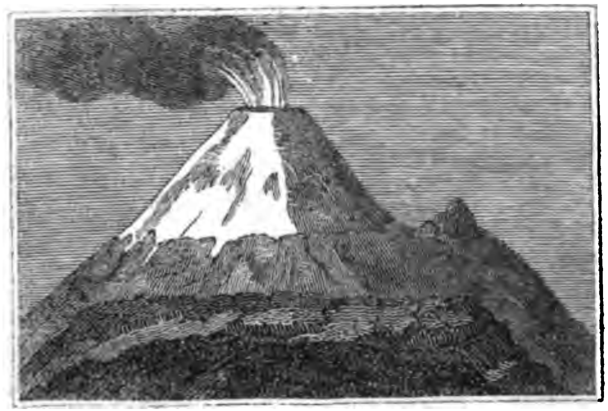
This is the most majestic of the Andes, and has a circular summit, 22,000 feet, or above four miles high. On the shores of the South Sea, after the long rains of winter, when the mistiness of the air has suddenly diminished, Chimborazo appears like a cloud in the horizon. It detaches itself from the neighbouring summits, and raises its lofty head over the whole chain of the Andes. Travellers who have approached the summits of Mont Blanc and Mont Rose, are alone capable of feeling the effect of such vast, majestic, and solemn scenery.

The bulk of Chimborazo is so enormous, that the part which the eye embraces at once, near the limit of the snows, is 22,968 feet, or four miles and a third in breadth. The extreme rarity of the strata of air, across which the summits of the Andes are seen, contributes greatly to the splendour of the snow, and the magical effect of its reflection. Under the tropics, at a height of 16,400 feet, upwards of three miles, the azure vault of the heavens appears of an indigo tint; while, in so pure and transparent an atmosphere, the outlines of the mountains detach themselves from the sky, and produce an effect at once sublime, awful, and profoundly impressive.

With the exception of the newly-discovered Asiatic mountains, Chimborazo is the highest known mountain in the world. Humboldt, Bonpland, and Montufar, were persevering enough to approach within 1600 feet of the summit of this mighty king of mountains. Being aided in their ascent by a train of volcanic rocks, destitute of snow, they thus attained the amazing height of nearly four miles above the level of the sea; and the former of these naturalists is persuaded that they might have reached the highest summit, had it not been for the intervention of a great crevice, or gap, which they were unable to cross. They were, therefore, obliged to descend, after experiencing great inconveniences, and many unpleasant sensations. For three or four days, even after their return into the plain, they were not free from sickness, and an uncomfortable feeling, owing, as they suppose, to the vast proportion



No. 4.—Chimborazo.



No. 5.—Cotopaxi.

of oxygen in the atmosphere above. Long before they reached the above *surprising height*, they had been abandoned by their guides, the Indians, *who had* taken alarm, and were fearful of their lives. So great *was* the fall of snow on their return, that they could *scarcely* recognize each other, and they all suffered dreadfully from the inteneness of the cold.

A great number of Spaniards formerly perished in crossing the vast and dangerous deserts which lie on the *declivity of Chimborazo*; being now, however, better acquainted with them, such *misfortunes* seldom occur, especially as very few take this route, unless *there* be a prospect of calm and serene weather.

COTOPAXI.

[*See Plate, No.* 5.]

This mountain is the loftiest of those volcanoes of the Andes which, at recent epochs, have undergone eruptions. Notwithstanding it lies near the Equator, its summits are covered with perpetual snows. The absolute height of Cotopaxi, *is 18,876* feet, or three miles and a half, consequently *it is 2,622* feet, or half a mile, higher than Vesuvius would be, were that mountain placed on the top of the Peak of Teneriffe! Cotopaxi is the most mischievous of the volcanoes in the kingdom of Quito, and its explosions are the most frequent and disastrous. The masses of scoriæ, and the pieces of rock, thrown out of this volcano, cover a surface of several square leagues, and would form, were they heaped together, a prodigious mountain. In 1738, the flames of Cotopaxi rose 3000 feet, or upwards *of half a mile*, above the brink of the crater. In 1744, the roarings of this volcano were heard at the distance of six hundred miles. On the 4th of April, 1768, the quantity of ashes ejected at the mouth of Cotopaxi was so great, that it was dark till three in the afternoon. The explosion which took place in 1803, was preceded by the sudden melting of the snows which covered the mountain. For twenty years before no smoke or vapour, that could be perceived, had issued from the crater; but in a single night the subterraneous fires became so active, that at sun-rise the external walls of the cone, heated to a very considerable temperature, appeared naked, and of the dark colour

which is peculiar to vitrified scoriæ. "At the port of Guayquil," observes Humboldt, "fifty-two leagues distant in a strait line from the crater, we heard, day and night, the noise of this volcano, like continued discharges of a battery; and we distinguished these tremendous sounds even on the Pacific Ocean."

The form of Cotopaxi is the most beautiful and regular of the colossal summits of the high Andes. It is a perfect cone, which, covered with a perpetual layer of snow, shines with dazzling splendour at the setting of the sun, and detaches itself in the most picturesque manner from the azure vault above. This covering of snow conceals from the eye of the observer even the smallest inequalities of the soil; no point of rock, no stony mass, penetrating this coat of ice, or breaking the regularity of the figure of the cone.

PICHINCHA.

Though celebrated for its great height, Pichincha is 3,849 feet, or three-fourths of a mile, lower than the perpendicular elevation of Cotopaxi. It was formerly a volcano; but the mouth or crater on one of its sides is now covered with sand or calcined matter, so that at present neither smoke nor ashes issue from it.

When it was ascended by Don George Juan and Don Antonio de Ulloa, for the purpose of their astronomical observations, they found the cold on the top of this mountain extremely intense, the wind very violent, and the fog, or, in other words, the cloud, so thick, that objects at the distance of six or eight paces were scarcely discernible. On the air becoming clear, by the clouds descending nearer the earth, in such a manner as to surround the mountain on all sides to a vast distance, these clouds afforded a lively representation of the sea, in which the top of the mountain seemed to stand, like an island in the centre.

With aspect mild, and elevated eye,
Behold him seated on a mount serene,
Above the fogs of sense, and passion's storm:
All the black cares and tumults of this life,
Like harmless thunders, breaking at his feet,
Excite his pity, not impair his peace.

Young.

When the clouds descended, the astronomers heard the dreadful noise of tempests, which discharged themselves from them on the adjacent country. They saw the lightning issue from the clouds, and heard the thunder roll far beneath them. While the lower parts were thus involved in tempests of thunder and rain, they enjoyed a delightful serenity; the wind abated, the sky cleared, and the enlivening rays of the sun moderated the severity of the cold. But when the clouds rose, their density rendered respiration difficult: snow and hail fell continually, and the winds returned with such violence, that it was impossible to overcome the fear of being blown down the precipices, or of being buried by the accumulation of ice and snow, or by the enormous fragments of rocks which rolled around them. Every crevice in their hut was stopped, and, though the hut was small, was crowded with inhabitants, and several lamps were constantly burning, the cold was so great, that each individual was obliged to have a chafing-dish of coals, and several men were employed every morning in removing the snow which had fallen during the night. Their feet were swollen, and they became so tender and sensible, that walking was attended with extreme pain; their hands also were covered with chilblains, and their lips were so swollen and chapped, that every motion in speaking brought blood.

MOUNT ETNA,

IN THE ISLAND OF SICILY.

[*See Plates, No.* 6, 7, 8, 9.]

Now under sulphurious Cuma's sea-bound coast,
And vast Sicilia, lies the shaggy breast
Of snowy Ætna, nurse of endless frost,
The pillared prop of heaven, for ever pressed:
Forth from whose sulph'rous caverns issuing rise
Pure liquid fountains of tempestuous fire,
Which veil in ruddy mists the noon-day skies,
While wrapt in smoke the eddying flames aspire,
Or gleaming through the night with hideous roar,
Far o'er the redd'ning main huge rocky fragments pour.

But he, Vulcanian monster, to the clouds
The fiercest, hottest inundations throws,
While, with the burthen of incumbent woods,
And Ætna's gloomy cliffs o'erwhelmed he glows.

There on his flinty bed outstretch'd he lies,
Whose pointed rock his tossing carcase wounds:
There with dismay he strikes beholding eyes,
Or frights the distant ear with horrid sounds.

WEST.

THE majestic Etna, which the ancients considered, not unreasonably, as one of the highest mountains in the world, and on the summit of which they believed that Deucalion and Pyrrha sought refuge, to save themselves from the universal deluge, is situated on the plain of Catania, in Sicily.

Its elevation above the level of the sea has been estimated at 10,963 feet, upwards of two miles. On clear days it is distinctly seen from Valetta, the capital of Malta, a distance of 150 miles. It is incomparably the largest burning mountain in Europe. From its sides other mountains arise, which, in different ages, have been ejected in single masses from its enormous crater. The most extensive lavas of Vesuvius do not exceed seven miles in length, while those of Etna extend to fifteen, twenty, and some even to thirty miles. The crater of Etna is seldom less than a mile in circuit, and sometimes is two or three miles; but the circumference of the Vesuvian crater is never more than half a mile, even when widely distended, in its most destructive conflagrations. Lastly, the earthquakes occasioned by these adjacent volcanoes, their eruptions, their showers of ignited stones, and the destruction and desolation which they create, are severally proportionate to their respective dimensions.

A journey up Etna is considered as an enterprise of importance, as well from the difficulty of the route, as from the distance, it being thirty miles from Catania to the summit of the mountain. Its gigantic bulk, its sublime elevation, and the extensive, varied, and grand prospects which are presented from its summit, have, however, induced the curious in every age to ascend and examine it; and not a few have transmitted, through the press, the observations which they have made during their arduous journey.—From its vast base it rises like a pyramid to the perpendicular height of two miles, by an acclivity nearly equal on all sides, forming with the horizon an angle of about fifteen degrees, which becomes greater on approaching



No. 6.—Distant View of Etna.



No. 7.—Etna by Moonlight.

the crater; but the inclination of the steepest part of the cone no where exceeds an angle of forty-five degrees. This prodigious volcano may be compared to a forge, which, in proportion to the violence of the fire, to the nature of the fossil matters on which it acts, and of the gases which urge and set it in motion, produces, destroys, and reproduces, a variety of forms.

The top of Etna being above the common region of vapours, the heavens, at this elevation, appear with an unusual splendour. Brydone and his company observed, as they ascended in the night, that the number of the stars seemed to be infinitely increased, and the light of each was brighter than usual. The whiteness of the milky way was like a pure flame which spread across the heavens; and, with the naked eye, they could observe clusters of stars which were invisible from below. They likewise noticed several of those meteors called falling stars, which appeared as much elevated here as when viewed from the plain beneath.

This single mountain contains an epitome of the different climates throughout the world, presenting at once all the seasons of the year, and all the varieties of produce. It is accordingly divided into three distinct zones or regions, which may be distinguished as the torrid, temperate, and frigid, but which are known by the names of the cultivated region, the woody or temperate region, and the frigid or desert region. The former of these extends through twelve miles of the ascent towards the summit, and is almost incredibly abundant in pastures and fruit-trees of every description. It is covered with towns, villages, and monasteries; and the number of inhabitants spread over its surface is estimated at 120,000. In ascending to the woody or temperate region, the scene changes; it is a new climate, a new creation. Below, the heat is suffocating; but here, the air is mild and fresh. The turf is covered with aromatic plants; and the gulfs, which formerly ejected torrents of fire, are changed into woody vallies. Than this nothing can be more picturesque, the inequality of the soil displaying every moment some variety of scene: here, the ash and flowering thorns form domes of verdure; and there, the chesnut-trees grow to an enormous size. The one called *castagno de cento cavalli*, according to Brydone and Glo-

ver, has a circumference of 204 feet. Many of the oaks also are of a prodigous size. Mr. Swinburne measured one which had a circumference of 28 feet. The last, or desert region, commences more than a mile above the level of the sea. The lower part is covered with snow in winter only; but on the upper half of this sterile district the snows continually lie.

Sometimes the pencil, in cool airy halls,
Bade the gay bloom of vernal landscapes rise,
Or Autumn's varied shades imbrown the walls:
Now the black tempest strikes th' astonished eyes,
Now down the steep the flashing torrent flies;
The trembling sun now plays o'er ocean blue,
And now rude mountains frown amid the skies;
Whate'er Lorraine light-touched with soft'ning hue,
Or savage Rosa dashed, or learned Poussin drew.

THOMSON.

The upper part, which may properly be called the cone of Etna, is, in a right line, about a mile, or somewhat more, in ascent. It is described by Sir William Hamilton as a little mountain, about a quarter of a mile perpendicular, and very steep, situated in the middle of a gently-inclined plane, about nine miles in circumference. The cavity was, according to his perception, shaped like a funnel, diminishing until it terminated in a point, and having an outer circumference of two miles and a half round.—Great changes have since taken place. Spallanzani also reached the edge of the crater, and found it to be an oval of about a mile and a half in circuit, having its edges in many places indented by projecting lavas or scoriæ. The bottom was nearly a horizontal plane, about two-thirds of a mile in circumference: hence issued a constant column of smoke, and hence, as well as from the sides, arose several streams of smoke, resembling thin clouds. Within the aperture a liquid ignited matter was clearly seen, constantly undulating, boiling, rising and falling, without spreading over the bottom. This was, no doubt, the melted lava which had issued from the bottom of the gulf. Neither of the above travellers, nor Brydone, dared to venture down the crater, which they found too hot; but M. D'Orville, more adventurous, by the means of ropes, which two or three men held at a distance, descended as far as possible.

His view was, in a great measure, intercepted by the small flames and smoke; but in the centre he saw a mass of matter, which rose in the shape of a cone, to the height of about sixty feet.

On the vastness and beauty of the prospect from the summit of Etna, all authors agree; and Spallanzani observes, that there is not, perhaps, any elevated region on the whole globe which offers at one view so fine an extent of the sea and land. M. Houel was stationed there at sun-rise, when the horizon was clear, and without a single cloud. The coast of Calabria was, he says, undistinguishable from the adjoining sea; but in a short time a fiery radiance began to appear from behind those Italian hills which bounded the eastern part of the prospect. The fleecy clouds which generally appear early in the morning, were tinged with purple; the atmosphere became strongly illuminated, and, reflecting the rays of the sun, seemed to be filled with a bright refulgence of flame. Although the heavens were thus enlightened, the sea still retained its dark azure, and the fields and forests did not yet reflect the rays of the sun. The gradual rising of this luminary, however, soon diffused light over the hills which lie below the peak of Etna. This last stood like an island in the midst of the ocean, with luminous points multiplying every moment around, and spreading over a wider extent with the greatest rapidity. It was, he said, as if the world had been observed suddenly to spring from the night of non-existence.

Ere the rising sun
Shone o'er the deep, or 'mid the vault of night
The moon her silver lamp suspended: ere
The vales with springs were watered, or with groves
Of oak or pine the ancient hills were crowned;
Then the Great Spirit, whom his works adore,
Within his own deep essence viewed the forms,
The forms eternal of created things:
The radiant sun; the moon's nocturnal lamp;
The mountains and the streams: the ample stores
Of earth, of heaven, of Nature. From the first,
On that fall scene his love divine he fixed,
His admiration. Till, in time complete,
What he admired and loved his vital power
Unfolded into being. Hence the breath
Of life informing each organic frame:

Hence the green earth, and wild resounding waves;
Hence light and shade, alternate; warmth and cold;
And bright autumnal skies, and vernal showers,
And all the fair variety of things. AKENSIDE.

The most sublime object, however, which the summit of Etna presents, is the immense mass of its own colossal body. Its upper region exhibits rough and craggy cliffs, rising perpendicularly, fearful to the view, and surrounded by an assemblage of fugitive clouds, to increase the wild variety of the scene. Amid the multitude of woods in the middle or temperate region, are numerous mountains, which, in any other situation, would appear of a gigantic size, but which, compared to Etna, are mere mole-hills. Lastly, the eye contemplates with admiration the lower region, the most extensive of the three, adorned with elegant villas and castles, verdant hills and flowery fields, and terminated by the extensive coast, where to the south, stands the beautiful city of Catania, to which the waves of the neighbouring sea serve as a mirror.

Etna has been celebrated as a volcano from the remotest antiquity. Eruptions are recorded by Diodorus Siculus as having happened 500 years before the Trojan war, or 1693 years before the Christian era.

Ætna roars with dreadful ruins nigh,
Now hurls a bursting cloud of cinders high,
Involved in smoky whirlwinds to the sky;
With loud displosion to the starry frame,
Shoots fiery globes, and furious floods of flame:
Now from her bellowing caverns burst away
Vast piles of melted rocks in open day.
Her shattered entrails wide the mountain throws,
And deep as hell her flaming centre glows.
WARTON.

In 1669, the torrent of burning lava inundated a space fourteen miles in length, and four in breadth, burying beneath it part of Catania, till at length it precipitated itself into the sea. For several months before the lava broke out, the old mouth, or great crater of the summit, was observed to send forth much smoke and flame, and the top had fallen in, so that the mountain was much lowered.

Eighteen days before, the sky was very thick and dark,



No. 19.—*Stromboli.*



No. 8.—*Great Crater of Etna.*



No. 10—Interior of the Crater of Vesuvius.



No. 9.—Crater of Etna.

with thunder, lightning, frequent concussions of the earth, and dreadful subterraneous bellowings. On the 11th of March, about sun-set, an immense gulf opened in the mountain, into which when stones were thrown, they could not be heard to strike the bottom. Ignited rocks, fifteen feet in length, were hurled to the distance of a mile; while others of a smaller size were carried three miles. During the night, the red-hot lava burst out of a vineyard twenty miles below the great crater, and ascended into the air to a considerable height. In its course it destroyed 5000 habitations, and filled up a lake several fathoms deep. It shortly after reached Catania, rose over the walls, whence it ran for a considerable length into the sea, forming a safe and beautiful harbour, which was, however, soon filled up by a similar torrent of inflamed matter. This is the stream, the hideous deformity of which, devoid of vegetation, still disfigures the south and western borders of Catania, and on which part of the noble modern city is built.

The showers of scoriæ and sand which, after a lapse of two days, followed this eruption, formed a mountain called *Monte Rosso*, having a base of about two miles, and a perpendicular height of 750 feet. On the 25th, the whole mountain, even to the most elevated peak, was agitated by a tremendous earthquake. The highest crater of Etna, which was one of the loftiest parts of the mountain, then sunk into the volcanic gulf, and in the place which it had occupied, there now appeared nothing but a wide gulf, more than a mile in extent, from which issued enormous quantities of smoke, ashes, and stones.

In 1809, twelve new craters opened about half way down the mountain, and threw out rivers of burning lava, by which several estates were covered to the depth of thirty or forty feet; and during three or four successive nights a very large river of red hot lava was distinctly seen, in its whole extent, running down from the mountain.

In 1811, several mouths opened on the eastern side of the mountain: being nearly in the same line, and at equal distances, they presented to the view a striking spectacle,—torrents of burning matter, discharged with the greatest force from the interior of the volcano, illuminated the horizon to a great extent. An immense quantity of matter, which was driven to considerable distances, was dis-

charged from these apertures, the largest of which continued for several months to emit torrents of fire. Even at the time when it had the appearance of being choaked, there suddenly issued from it clouds of ashes, which descended, in the form of rain, on the city of Catania and its environs, as well as on the fields situated at a very considerable distance. A roaring, resembling that of a sea in the midst of a tempest, was heard to proceed from the interior of the mountain; and this sound, accompanied from time to time by dreadful explosions, resembling thunder, reechoed through the vallies and spread terror on every side.

MOUNT VESUVIUS,

NEAR NAPLES.

[*See Plates, No.* 10, 11, 12, 13.]

The fluid lake that works below,
Bitumen, sulphur, salt, and iron scum,
Heaves up its boiling tide. The lab'ring mount
Is torn with agonizing throes. At once,
Forth from its sides disparted, blazing pours
A mighty river; burning in prone waves,
That glimmer thro' the night, to yonder plain
Divided there, a hundred torrent streams,
Each ploughing up its bed, roll dreadful on,
Resistless. Villages, and woods, and rocks,
Fall flat before their sweep. The region round,
Where myrtle walks and groves of golden fruit
Rose fair; where harvest wav'd in all its pride;
And where the vineyard spread its purple store,
Maturing into nectar; now despoiled
Of herb, leaf, fruit, and flower, from end to end
Lies buried under fire, a glowing sea! MALLET.

This celebrated volcano, which has for so many ages attracted the attention of mankind, and the desolating eruptions of which have been so often and so fatally experienced, is distant, in an eastern direction, about seven miles from Naples. It rises, insulated, upon a vast and well-cultivated plain, presenting two summits on the same base, in which particular it resembles Mount Parnassus. One of these, La Somma, is generally agreed to have been the Vesuvius of Strabo and the ancients; the other, having the greatest elevation, is the mouth of the volcano, which almost constantly emits smoke. Its height above the lev-

el of the sea, is 3,900 feet, and it may be ascended by three different routes, which are all very steep and difficult, from the conical form of the mountain, and the loose ashes which slip from under the feet: still, from the base to the summit the distance is not more than three Italian miles. The circumference of the platform on the top, is 5,024 feet, or nearly a mile. Thence may be seen Portici, Capræa, Ischia, Pausilippo, and the whole coast of the gulf of Naples, bordered with orange trees: the prospect is that of Paradise seen from the infernal regions.

On approaching the mountain, its aspect does not convey any impression of terror, nor is it gloomy, being cultivated for more than two-thirds of its height, and having its brown top alone barren. There all verdure ceases; yet, when it appears covered with clouds, which sometimes encompass its middle only, this circumstance rather adds to than detracts from the magnificence of the spectacle. Upon the lavas which the volcano long ago ejected, and which, like great furrows, extend into the plain, and to the sea, are built houses, villages, and towns. Gardens, vineyards, and cultivated fields, surround them; but a sentiment of sorrow, blended with apprehensions about the future, arises on the recollection that, beneath a soil so fruitful and so smiling, lie edifices, gardens, and whole towns swallowed up. Portici rests upon Herculaneum; its environs upon Resina; and at a little distance is Pompeii, in the streets of which, after more than seventeen centuries of non-existence, the astonished traveller now walks. After a long interval of repose, in the first year of the reign of Titus, (the seventy ninth of the Christian era,) the volcano suddenly broke out, ejecting thick clouds of ashes and pumice stones, beneath which Herculaneum, Stabia, and Pompeii, were completely buried. This eruption was fatal to the elder Pliny, the historian, who fell a victim to his humanity and love of science. Even at this day, in speaking of Vesuvius, the remembrance of his untimely death excites a melancholy regret. All the coast to the east of the gulf of Naples was, on the above occasion, ravaged and destroyed, presenting nothing but a long succession of ejected matters from Herculaneum to Stabia. The destruction did not extend to the western part, but stopped at Naples, which suffered comparitively little.

Thirty-eight eruptions of Vesuvius are recorded in history up to the year 1806. That of 1779 has been described by Sir William Hamilton as among the most remarkable from its extraordinary and terrific appearance. During the whole of July the mountain was in a state of considerable fermentation, subterraneous explosions and rumbling noises being heard, and quantities of smoke thrown up with great violence, sometimes with red-hot stones, scoriæ, and ashes. On the 5th of August the volcano was greatly agitated, a white sulphurous smoke, apparently four times the height and size of the volcano itself, issuing from the crater, at the same time that vast quantities of stones, &c. were thrown up to the supposed height of 2000 feet. The liquid lava, having cleared the rim of the crater, flowed down the sides of the mountain to the distance of four miles. The air was darkened by showers of reddish ashes, blended with long filaments of a vitrified matter resembling glass.

On the 7th, at midnight, a fountain of fire shot up from the crater to an incredible height, casting so bright a light that the smallest objects were clearly distinguishable at any place within six miles of the volcano. On the following evening, after a tremenduous explosion, which broke the windows of the houses at Portici, another fountain of liquid fire rose to the surprising height of 10,000 feet, (nearly two miles,) while puffs of the blackest smoke accompanied the red-hot lava, interrupting its splendid brightness here and there by patches of the darkest hue. The lava was partly directed by the wind towards Ottainano, on which so thick a shower of ashes, blended with vast pieces of scoriæ, fell, that, had it been of longer continuance, that town would have shared the fate of Pompeii. It took fire in several places; and had there been much wind, the inhabitants would have been burned in their houses, it being impossible for them to stir out. To add to the horror of the scene, incessant volcanic lightning darted through the black cloud that surrounded them, while the sulphureous smell and heat would scarcely allow them to draw their breath. In this dreadful state they remained nearly half an hour. The remaining part of the lava, still red-hot and liquid, fell on the top of Vesuvius, and covered its whole cone, together with that of La Somma, and the valley



No. 11.—Cloud of Smoke issuing from Mount Vesuvius.

between them, thus forming one complete body of fire, which could not be less than two miles and a half in breadth, and casting a heat to the distance of at least six miles around.

The eruption of 1794 is accurately described by the above writer; but has not an equal degree of interest with the one cited above. We subjoin a few particulars, among which is a circumstance well deserving notice, as it leads to an estimate of the degree of heat in volcanoes. Sir William says that although the town of Torre del Greco was instantly surrounded with red-hot lava, the inhabitants saved themselves by coming out of the tops of their houses on the following day. It is evident, observes Mr. Kirwan, that if this lava had been hot enough to melt even the most fusible stones, these persons must have been suffocated.

This eruption happened on the 15th of June, at ten o'clock at night, and was announced by a shock of an earthquake, which was distinctly felt at Naples. At the same moment a fountain of bright fire, attended with a very black smoke and a loud report, was seen to issue, and rise to a considerable height, from about the middle of the cone of Vesuvius. It was hastily succeeded by other fountains, fifteen of which were counted, all in a direct line, tending for the space of about a mile and a half downward, towards the towns of Resina and Torre del Greco. This fiery scene—this great operation of nature—was accompanied by the loudest thunder, the incessant reports of which, like those of a numerous heavy artillery, were attended by a continued hollow murmur, similar to that of the roaring of the ocean during a violent storm. Another blowing noise resembled that of the ascent of a large flight of rockets. The houses at Naples were for several hours in a constant tremour, the doors and windows shaking and rattling incessantly, and the bells ringing. At this awful moment the sky, from a bright full-moon, and star-light, became obscured; the moon seemed eclipsed, and was soon lost in obscurity. The murmur of the prayers and lamentations of a numerous population, forming various processions, and parading the streets, added to the horrors of the scene.

On the following day a new mouth was opened on the

opposite side of the mountain, facing the town of Ottaiano: from this aperture a considerable stream of lava issued, and ran with great velocity through a wood, which it burnt; but stopped, after having run about three miles in a few hours, before it reached the vineyards and cultivated lands. The lava which had flowed from several new mouths on the south-side of the mountain, reached the sea into which it ran, after having overwhelmed, burnt, and destroyed the greater part of Torre del Greco, through the centre of which it took its course. This town contained about 18,000 inhabitants, all of whom escaped, with the exception of about fifteen, who through age or infirmity, were overwhelmed in their houses by the lava. Its rapid progress was such, that the goods and effects were entirely abandoned.

It was ascertained sometime after, that a considerable part of the crater had fallen in, so as to have given a great extension to the mouth of Vesuvius, which was conjectured to be nearly two miles in circumference. This sinking of the crater was chiefly on the west side, opposite Naples, and, in all probability, occurred early in the morning of the 18th, when a violent shock of an earthquake was felt at Resina, and other places situated at the foot of the volcano. The clouds of smoke which issued from the now widely extended mouth of Vesuvius, were of such a density as to appear to force their passage with the utmost difficulty. One cloud heaped itself on another, and, succeeding each other incessantly, they formed in a few hours such a gigantic and elevated column, of the darkest hue, over the mountain, as seemed to threaten Naples with immediate destruction, it having at one time been bent over the city, and appearing to be much too massive and ponderous to remain long suspended in the air.

From the above time till 1804 Vesuvius remained in a state of almost constant tranquility. Symptoms of a fresh eruption had manifested themselves for several months, when at length on the night of the 11th of August, a deep roaring was heard at the Hermitage of Salvador, and the places adjacent to the mountain, accompanied by shocks of an earthquake, which were sensibly felt at Resina. On the following morning, at noon, a thick black smoke rose from the mouth of the crater, which, dilating

prodigiously, covered the whole volcano. In the evening loud explosions were heard; and at Naples a column of fire was seen to rise from the aperture, carrying up stones in a state of complete ignition, which fell again into the crater. The noise by which these igneous explosions were accompanied resembled the roaring of the most dreadful tempest, and the whistling of the most furious winds; while the celerity with which the substances were ejected was such, that the first emission had not terminated when it was succeeded by a second. Small monticules were at this time formed of a fluid matter, resembling a vitreous paste of a red colour, which flowed from the mouth of the crater; and these became more considerable in proportion as the matter accumulated.

In this state the eruption continued for several days, the fire being equally intense, with frequent and dreadful noises. On the 28th, amid these fearful symptoms, another aperture, ejecting fire and stones, situated behind the crater, was seen from Naples. The burning mass of lava which escaped from the crater on the following day, was distinguished from Torre del Greco, having the appearance of a vitreous fluid, and advancing towards the base of the mountain between the south and south-west. It reached the base on the 30th, having flowed from the aperture, in less than twenty-four hours, a distance of 3,053 feet, while its mean breadth appeared to be about 350, but at the base 860 feet. In its course it divided into four branches, and finally reached a spot called the Guide's Retreat. Its entire progress to this point was more than a mile, so that, taking a mean proportion, this lava flowed at the rate of eighty-six feet an hour.

At the time of this eruption Kotzebue was at Naples. Vesuvius lay opposite to his window, and when it was dark he could clearly perceive in what manner the masses of fire rolled down the mountain. As long as any glimmering of light remained, that part of the mountain was to be seen, on the declivity of which the lava formed a straight but oblique line. As soon, however, as it was perfectly dark, and the mountain itself had vanished from the eye, it seemed as if a comet with a long tail stood in the sky. The spectacle was awful and grand!

He ascended the mountain on the morning succeeding

the opening of a new gulf, and approached the crater as nearly as prudence would allow. From its centre ascended the sulphurous yellow cone which the eruption of this year had formed : on the other side, a thick smoke perpetually arose from the abyss opened during the preceding night. The side of the crater opposite to him, which rose considerably higher than that on which he stood, afforded a singular aspect ; for it was covered with little pillars of smoke, which burst forth from it, and had some resemblance to extinguished lights. The air over the crater was actually embodied, and was clearly to be seen in a tremulous motion. Below, it boiled and roared dreadfully, like the most violent hurricane ; but occasionally a sudden deadly stillness ensued for some moments, after which the roaring recommenced with double vehemence, and the smoke burst forth in thicker and blacker clouds. It was, he observes, as if the spirit of the mountain had suddenly tried to stop the gulf, while the flames indignantly refused to endure the confinement.

It is remarkable, that the great eruption of 1805 happened on the 12th of August, within a day of that of the preceding year. Subterraneous noises had been previously heard, and a general apprehension of some violent commotion prevailing, the inhabitants of Torre del Greco and Annunciada had left their homes, through the apprehension of a shower of fire and ashes, similar to that which buried Pompeii. The stream of lava took the same course with that of 1794, described above, one of the arms following the direction of the great road, and rolling towards the sea. The stream soon divided again, and spreading itself with an increased celerity, swept away many houses and the finest plantations. The other branch, at first, took the direction of Portici, which was threatened ; but turning, and joining the preceding one, formed a sort of islet of boiling lava in the middle, both ending in the sea, and composing a promontory of volcanic matters. In the space of twenty minutes the whole extent of ground which the lava occupied was on fire, offering a terrible yet singular spectacle, as the burning trees presented the aspect of white flames, in contrast with those of the volcanic matters, which were red. The lava swept along with it enormous masses of whatever occurred in its course, and, on its



No. 12.—Vesuvius and Naples.



No. 13.—Vesuvius in Eruption.

reaching the sea, nothing was to be seen or heard for a great extent of shore, beside the boiling and hissing arising from the conflict of the water and fire.

It remains now to introduce a slight notice of the eruption of 1806, which, without any sensible indication, took place on the evening of the 31st of May, when a bright flame rose from the mountain to the height of about 600 feet, sinking and rising alternately, and affording so clear a light, that a letter might have been read at the distance of a league around the mountain. On the following morning, without any earthquake preceding, as had been customary, the volcano began to eject inflamed substances from three new mouths, pretty near to each other, and about 650 feet from the summit. The lava took the direction of Torre del Greco and Annunciada, approaching Portici, on the road leading from Naples to Pompeii. Throughout the whole of the second of June, a noise was heard, resembling that of two armies engaged, when the discharges of artillery and musketry are very brisk. The current of lava now resembled a wall of glass in a state of fusion, sparks and flashes issuing from it from time to time, with a powerful detonation. Vines, trees, houses,—whatever objects, in short, it encountered on its way, were instantly overthrown or destroyed. In one part, where it met with the resistance of a wall, it formed a cascade of fire. In a few days Portici, Resina, and Torre del Greco, were covered with ashes thrown out by the volcano; and, on the ninth, the two former places were deluged with a thick black rain, consisting of a species of mud filled with sulphureous particles. On the first of July, the ancient crater had wholly disappeared, being filled with ashes and lava, and a new one was formed in the eastern part of the mountain, about 600 feet in depth, and having about the same width at the opening. Several persons, on the above day, descended about half way down this new mouth, and remained half an hour very near the flames, admiring the spectacle presented by the liquid lava, which bubbled up at the bottom of the crater, like the fused matter in a glass-house. This eruption continued until September, made great ravages, and was considered as one of the most terrible that had occurred in the memory of the inhabitants.

MOUNT HECLA,

IN ICELAND.

[*See Plate, No.* 14.]

Still pressing on beneath Tornea's lake,
And Hecla flaming through a waste of snow,
And farthest Greenland, to the Pole itself,
Where, falling gradual, life at length goes out,
The Muse expands her solitary flight;
And hov'ring o'er the wide stupenduous scene,
Beholds new scenes beneath another sky.
Throned in his palace of cerulean ice,
Here winter holds his unrejoicing court,
And through his airy hall the loud misrule
Of driving tempest is for ever heard;
Here the grim tyrant meditates his wrath;
Here arms his winds with all subduing frost,
Moulds his fierce hail, and treasures up his snows.

On proceeding along the southern coast of Iceland, and at an inconsiderable distance from Skaalholt, this mountain, with its three summits, presents itself to the view. Its height is five thousand feet, or nearly a mile above the level of the sea. It is not a promontory, but lies about four miles inland. It is neither so elevated nor so picturesque as several of the surrounding Icelandic mountains; but has been more noticed than many other volcanoes of an equal extent, partly through the frequency of its eruptions, and partly from its situation, which exposes it to the view of many ships sailing to Greenland and North America. The surrounding territory has been so devastated by these eruptions, that it has been deserted.

Vast regions dreary, bleak, and bare!
There on an icy mountain's height,
Seen only by the Moon's pale light,
Stern Winter rears his giant form,
His robe a mist, his life a storm:
His frown the shiv'ring nations fly,
And, hid for half the year, in smoky caverns lie.

The natives asserted that it was impossible to ascend the mountain, on account of the great number of dangerous bogs, which according to them, are constantly emitting sulphureous flames, and exhaling smoke; while the

more elevated summit in the centre is covered with boiling springs and large craters, which continually propel fire and smoke. To the south and west the environs present the most afflicting results of frequent eruptions, the finest part of the territory being covered by torrents of melted stone, sand, ashes, and other volcanic matter; notwithstanding which, between the sinuosities of the lava in different parts, some portion of meadows, walls, and broken hedges may be observed. The devastation is still greater on the north and east sides, which present dreadful traces of the ruin of the country and its habitations. Neither plants nor grass are to be met with to the extent of two leagues round the mountain, in consequence of the soil being covered with stones and lava; and in some parts, where the subterraneous fire has broken out a second time, or where the matter which was not entirely consumed has again become ignited, the fire has contributed to form small red and black hillocks and eminences, from scoriæ, pumice-stones, and ashes. The nearer the mountain the larger are these hillocks, and there are some of them, the summits of which form a circular hollow, whence the subterraneous fire ejects the matter. On approaching Hecla the ground becomes almost impassable, particularly near the higher branches of lava thrown from the volcano. Round the latter is a mountain of lava, consisting of large fused stones, from forty to seventy feet high, and in the form of a rampart or wall. These stones are detached, and chiefly covered with moss; while between them are very deep holes, so that the ascent on the western side requires great circumspection. The rocks are completely reduced to pumice, dispersed in thin horizontal layers, and fractured in every direction, from which some idea may be formed of the intensity of the fire that has acted on them.

There Winter, armed with terrors here unknown,
Sits absolute on his unshaken throne;
Piles up his stores amidst the frozen waste,
And bids the mountains he has built stand fast,
Beckons the legions of his storms away
From happier scenes to make the land a prey:
Proclaims the soil a conquest he has won,
And scorns to share it with the distant sun.

Sir Joseph Banks, Dr. Solander, Dr. James Lind, of

Edinburgh, and Dr. Van Troil, a Swede, were the earliest adventurous travellers who ascended to the summit of Mount Hecla. This was in 1772; and the attempt was facilitated by a preceding eruption in 1766, which had greatly diminished the steepness and difficulty of the ascent. On their first landing, they found a tract of land sixty or seventy miles in extent, entirely ruined by lava, which appeared to have been in a state of complete liquefaction. To accomplish their undertaking, they had to travel from three hundred to three hundred and sixty miles over uninterrupted tracts of lava. In ascending, they were obliged to quit their horses at the first opening from which the fire had burst:—a spot, which they describe as presenting lofty glazed walls and high glazed cliffs, differing from any thing they had ever seen before. At another opening above, they fancied they discerned the effects of boiling water; and not far from thence, the mountain, with the exception of some bare spots, was covered with snow. This difference of aspect they soon perceived to be occasioned by the hot vapour ascending from the mountain. The higher they proceeded, the larger these spots became; and, about two hundred yards below the summit, a hole about a yard and a half in diameter, was observed, whence issued so hot a stream, that they could not measure the degree of heat with a thermometer. The cold now began to be very intense. Fahrenheit's thermometer, which at the foot of the mountain was at 54, fell to 24; while the wind became so violent, that they were sometimes obliged to lie down, from a dread of being blown into the most dreadful precipices. On the summit itself they experienced, at one and the same time, a high degree of heat and cold; for, in the air, Fahrenheit's thermometer constantly stood at 24, but when placed on the ground, it rose to 153.

Messrs. Olafsen and Povelsen, two naturalists, whose travels in Iceland were undertaken by order of his Danish Majesty, after a fatiguing journey up several small slopes, which occurred at intervals, and seven of which they had to pass, at length reached the summit of Mount Hecla at midnight. It was as light as at noon day, so that they had a view of an immense extent, but could perceive nothing but ice: neither fissures, streams of water, boiling springs, smoke, nor fire, were apparent. They surveyed the gla-



No. 14.—Hecla.



No. 15.—The Geysers and Hecla.

ciers in the eastern part, and in the distance saw the high and square mountain of Hærdabreid, an ancient volcano, which appeared like a large castle.

Sir G. S. Mackenzie, in his recent travels in Iceland, ascended Mount Hecla; and from his account we extract the following interesting particulars. In proceeding to the southern extremity of the mountain, he descended, by a dangerous path, into a valley, having a small lake in one corner, and the opposite extremity bounded by a perpendicular face of rock, resembling, in its broken and rugged appearance, a stream of lava. While advancing, the sun suddenly broke through the clouds, and the brilliant reflection of his beams, from different parts of this supposed lava, as if from a surface of glass, delighted our traveller by the instantaneous conviction that he had now attained one of the principal objects connected with the plan of his expedition to Iceland. He hastened to the spot, and all his wishes were fully accomplished in the examination of an object which greatly exceeded the expectations he had formed. On ascending one of the abrupt pinnacles, which rose out of this extraordinary mass of rock, he beheld a region, the desolation of which can scarcely be paralleled. Fantastic groups of hills, craters, and lava, leading the eye to distant snow-crowned jockuls, (inferior mountains,) the mist rising from a water-fall; lakes, embosomed among bare bleak mountains; an awful profound silence; lowering clouds; marks all around of the furious action of the most destructive of elements; all combined to impress the soul with sensations of dread and wonder. The longer himself and his companions contemplated this scene, the more unable they were to turn their eyes from it; and a considerable time elapsed before they could bring themselves to attend to the business which had tempted them to enter so frightful a district of the country.

Having proceeded a considerable distance along the edge of a stream of lava, a narrow part of which they crossed, they gained the foot of the south-end of Mount Hecla. While, in ascending, they had to pass over rugged lava, they experienced no great difficulty in advancing; but when they reached the steepest part of the mountain, which was covered with loose slags, they sometimes lost at

one step by the yielding of these, a space which had been gained by several.

Having passed a number of fissures, by leaping across some, and stepping along masses of slags which lay over others, they at length reached the summit of the first peak. The clouds now became so thick, that they began to despair of being able to proceed any further: it was, indeed, dangerous even to move; for the peak consists of a very narrow ridge of slags, not more than two feet broad, having a precipice on each side, several hundred feet in depth. One of these precipices forms the side of a vast hollow, which seems to have been one of the craters. At length the sky cleared a little, and enabled them to discover a ridge below, which seemed to connect the peak they had ascended with the middle or principal one.—They lost no time in availing themselves of this opportunity, and, by balancing themselves like rope-dancers, succeeded in passing along a ridge of slags, so narrow that there was scarcely room for their feet. After a short, but very steep, ascent, they gained the highest part of this celebrated mountain.

Its earliest eruption is said to have happened in 1004, since which time upwards of twenty have occurred. That of 1693 was the most dreadful, and occasioned terrible devastations, the ashes having been thrown over the island in every direction, to the distance of more than one hundred miles. In 1728, a fire broke out among the surrounding lava; and also in that to the west of the volcano, in 1754, which lasted for three days. There has not been any eruption of lava since 1766; but for some years after flames issued from the volcano.

THE GEYSERS.

[*See Plate No.* 15.]

Nor stops the restless fluid, mounting still,
Tho' oft amid th' irriguous vale of springs;
But to the mountain courted by the sand,
That leads it darkling on in faithful maze,
Far from the parent main, it boils again!
Fresh into day; and all the glittering hill
Is bright with spouting rills.——

The crystal treasures of the liquid world,
Through the stirred sands a bubbling passage burst;
And welling out, around the middle steep,
Or from the bottoms of the bosomed hills,
In pure effusion flow. THOMPSON.

These celebrated fountains, or hot spouting water springs, being nearly connected with the operations of subterraneous fire, so visible in every part of Iceland, may be properly introduced after the description of Mount Hecla, given above.

They are seldom very near the volcanoes, but are dispersed over the whole country, and are even to be found on the summits of several of the ice mountains. The largest and most remarkable of these is situated in a large field, about sixteen miles to the north of Skalholt. At a great distance from it, on one side, are high mountains covered with ice, and on the other Hecla is seen rising above the clouds, while opposite to it is a ridge of rocks, at the foot of which water from time to time rushes forth. At the distance of a mile and a half a loud roaring noise is heard like that of a torrent precipitated from stupenduous rocks, each ejection being accompanied by violent subterraneous detonations. The depth of the opening from which the water rushes has not been ascertained, but some seconds elapse before a stone thrown in reaches the surface. The Danish traveller Olafsen, asserts, that the water rises as high as sixty fathoms; while Van Troil estimates the highest jet at not more than sixty feet: the latter allows, however, that the jets may be more elevated, particularly in bad weather. The greatness of the explosive power is evinced by its not only preventing stones thrown in from sinking, but even forcing them up to a very great height, together with the water, and splitting the pebbles into a thousand pieces. The heat was found by Van Troil to be two hundred and twelve degrees of Fahrenheit, the boiling point. The edges of the pipe or basin are covered by a coarse stalactitic rind, and the water has been found to have a petrifying quality. The opening is perfectly circular, in diameter nineteen feet, and forms above, on the surface of the ground, a basin fifty-nine feet in diameter, the edge of which is nine feet above the orifice or hole.

In speaking of the Geysers, or hot spouting springs,

Horrebow observes, that if you fill a bottle at one of them, the water it contains will boil three or four times, at the same time with the water in the well. The inhabitants boil their meat in it, by putting the meat in a vessel of cold water which they place in the hot spring.

Sir G. S. Mackenzie, whose recent travels in Iceland we have already cited, visited the Geysers at a season favourable to his observations, the latter end of July. He found the cultivation of the surrounding territory much higher than might have been inferred from the idea generally entertained of the barren and unproductive state of Iceland. All the flat ground in that quarter of the island was swampy, but not so much so as to impede the progress of the party, who, having passed several hot springs to the eastward of Skalholt, and others rising among the low hills they had left to the right, in proceeding to the great Geyser, came to a farm house, situated on a rising ground in the midst of the bogs. Here the people were busily employed in making hay, a scene which afforded a pleasing change from the dreary solitude they had quitted; the whole of this extensive district, which abounds in grass, would, if drained, our traveller observes, prove a very rich pasture country. Farther on they came to several cottages at the foot of the mountain, round which they turned, and came in sight of the hill, having the Geysers at one of its sides. This hill, in height not more than three hundred feet, is separated from the mountain, towards the west, by a narrow slip of flat boggy ground, connected with that which extends over the whole valley. Having crossed this bog, and a small river which ran through it, the party came to a farm house at the east end of the hill, and arrived at a spot where the most wonderful and awful effects of subterraneous heat are exhibited.

On the east-side of the hill there are several banks of clay, from some of which steam rises in different places; and in others there are cavities, in which water boils briskly. In a few of these cavities, the water being mixed with clay, is thick and varies in colour; but is chiefly red and grey. Below these banks there is a gentle and uniform slope, composed of matter which, at some distant period, has been deposited by springs which no longer exist. The strata or beds thus formed, seemed to have been broken

by shocks of earthquakes, particularly near the great Geyser. Within a space not exceeding a quarter of a mile, numerous orifices are seen in the old incrustations, from which boiling water and steam issue, with different degrees of force. At the northern extremity is situated the great Geyser, sufficiently distinguishable from the others by every circumstance connected with it. On approaching this spot it appeared that a mount had been formed of irregular, rough-looking depositions, upon the ancient regular strata, the origin of which had been similar. The slope of the latter has caused the mount to spread more on the east-side; and the recent depositions of the water may be traced till they coincide with them. The perpendicular height of the mount is about seven feet, measured from the highest part of the surface of the old depositions. From these the matter composing the mount may be readily distinguished, on the west side, where a disruption has taken place. On the top of this mount is a basin, which was found to extend fifty six feet in one direction, and forty-six in another.

At a quarter before three o'clock in the afternoon, when the party reached the spot, they found the basin full of hot water, a little of which was running over. Having satisfied their curiosity at that time, they proceeded to examine some other places, whence they saw water ascending.— Above the great Geyser, at a short distance, they came to a large irregular opening, the beauties of which, the writer observes, it is hardly possible to describe. The water. with which it was filled was as clear as crystal, and perfectly still, although nearly at the boiling point. Through it they saw white incrustations, forming a variety of figures and cavities, to a great depth, and carrying the eye into a vast and dark abyss, over which the crust supporting them formed a dome of an inconsiderable thickness; a circumstance which though not of itself agreeable, contributed much to the effects of this awful scene.

Having pitched their tent at the distance of about one hundred yards from the Geyser, and so arranged matters as that a regular watch might be kept during the night, Sir G. S. Mackenzie took his station at eleven o'clock, and his companions lay down to sleep. About ten minutes before twelve he heard subterraneous discharges, and waked his

friends. The water in the basin was greatly agitated, and flowed over, but there was not any jet. The same occurred at half past two. At five minutes past four on Saturday morning, an alarm was given by one of the company. As our traveller lay next the door of the tent, he instantly drew aside the canvass, when at the distance of little more than fifty yards, a most extraordinary and magnificent appearance presented itself. From a place they had not before noticed, they saw water thrown up, and steam issuing with a tremenduous noise. There was little water; but the force with which the steam escaped, produced a white column of spray and vapour, at least sixty feet high. They enjoyed this astonishing and beautiful sight until seven o'clock, when it gradually disappeared.

The remaining part of the morning was occupied in examining the environs of the Geysers; and at every step they received some new gratification. Following the channel which had been formed by the water escaping from the great basin during the eruptions, they found several beautiful and delicate petrifactions. The leaves of birch and willow were seen converted into white stone, and in the most perfect state of preservation, every minute fibre being entire. Grass and rushes were in the same state, and also masses of peat. Several of these rare and elegant specimens were brought safely to Great Britain. On the outside of the mount of the Geyser, the depositions, owing to the splashing of the water, are rough and have been justly compared to the heads of cauliflowers. They are of a yellowish brown colour, and are arranged around the mount, somewhat like a circular flight of steps. The inside of the basin is comparatively smooth; and the matter forming it is more compact and dense than the exterior crust; when polished it is not devoid of beauty, being of a grey colour, mottled with black and white spots and streaks. The white incrustation formed by the water of the beautiful cavity before described, had taken a very curious form at the water's edge, very much resembling the capital of a Gothic column.

THE SULPHUR MOUNTAIN.

This Icelandic mountain, distant about three miles from the village of Krisuvik, presents a phenomenon very different from the one above described, that of a CAULDRON OF BOILING MUD. We extract the following particulars of this singular curiosity from the relation given by Sir G. Mackenzie in his travels in Iceland.

At the foot of the mountain is a small bank, composed chiefly of white clay and sulphur, from every part of which steam issues. Having ascended this bank, a ridge presents itself, immediately beneath which is a deep hollow, whence a profusion of vapour arises, with a confused noise of boiling and splashing, accompanied by steam escaping from narrow crevices in the rock. This hollow being, as well as the whole side of the mountain opposite, covered with sulphur and clay, it was very hazardous to walk over a soft and steaming surface of such a description. The vapour concealing the party from each other occasioned much uneasiness; and there was some hazard of the crust of sulphur breaking, or of the clay sinking beneath their feet. They were thus several times in danger of being scalded, as indeed, happened to one of the party, Mr. Bright, who accidentally plunged one of his legs into the hot clay. When the thermometer was immersed in it, to the depth of a few inches, it generally rose to within a few degrees of the boiling point. By stepping cautiously, and avoiding every little hole from which steam issued, they soon ascertained how far they might venture. Their good fortune, however, Sir George observes, ought not to tempt any person to examine this wonderful place, without being provided with two boards, with which every part of the banks may be traversed in perfect safety. At the bottom of the hollow, above described, they found the cauldron of mud, which boiled with the utmost vehemence. They approached within a few yards of it, the wind favouring them in viewing every part of this singular scene. The mud was in constant agitation, and often thrown up to the height of six or eight feet. Near this spot was an irregular space filled with water, boiling briskly. At the foot of the

hill, in a hollow formed by a bank of clay and sulphur, steam rushed with great force and noise from among the loose fragments of rock.

In ascending the mountain, our travellers met with a spring of cold water, which was little to be expected in such a place. At a greater elevation, they came to a ridge, composed entirely of sulphur and clay, joining two summits of the mountain. The smooth crust of sulphur was beautifully chrystallized; and beneath it was a quantity of loose granular sulphur, which appeared to be collecting and chrystalizing, as it was sublimed along with the steam. On removing the sulphureous crust, steam issued, and annoyed the party so much, that they could not examine this place to any depth.

Beneath the ridge, on the farther side of this great bed of sulphur, an abundance of vapour escaped with a loud noise. Having crossed to the side of the mountain opposite, they walked to what is called the principal spring. This was a task of much apparent danger, as the side of the mountain to the extent of about half a mile, was covered with loose clay, into which the feet of our travellers sunk at every step. In many places there was a thin crust, beneath which the clay was wet, and extremely hot. Good fortune attended them; and without any serious inconvenience, they reached the object they had in view. A dense column of steam, mixed with a small portion of water, forced its way impetuously through a crevice in a rock, at the head of a narrow valley, or break in the mountain.—The violence with which it rushed out was so great, that the noise, thus occasioned, might often be heard at the distance of several miles. During night while the party lay in their tent at Krisuvik, they more than once listened to it with mingled awe and astonishment. Behind the column of vapour was a dark-coloured rock, which added to the sublimity of the effect.

"It is quite beyond my power," observes Sir George Mackenzie, "to offer such a description of this extraordinary place, as would convey adequate ideas of its wonders, or of its terrors. The sensations of a person, even of firm nerves, standing on a support which feebly sustains him, over an abyss where, literally, fire and brimstone are in dreadful and incessant action; having before his eyes tre-

mendous proofs of what is going on beneath him; enveloped in thick vapours; his ears stunned with thundering noises; must be experienced before they can be understood."

MONT BLANC,

IN SWITZERLAND, WITH THE GLACIERS.

[See *Plate, No.* 16.]

When mid the lifeless summits proud
Of Alpine cliffs, where to the geled sky
Snows piled on snows in wint'ry torpor lie,
The rays divine of vernal Phœbus play;
Th' awakened heaps, in streamlets from on high,
Roused into action, lively leap away,
Glad warbling through the vales, in their *new being gay*.
THOMPSON.

THIS mountain, so named on account of its white aspect, belongs to the great central chain of the Alps. It is truly gigantic, and is the most elevated mountain in Europe, rising no less than 15,872 feet, somewhat more than three miles, above the level of the sea, and 14,624 feet above the lake of Geneva, in its vicinity. It is encompassed by those wonderful collections of snow and ice, called "GLACIERS," two of the principal of which, are called Mont Dolent and Triolet. The highest part of Mont Blanc, named the Dromedary, is in the shape of a compressed hemisphere. From that point it sinks gradually, and presents a kind of concave surface of snow, in the midst of which is a small pyramid of ice. It then rises into a second hemisphere, which is named the Middle Dome; and thence descends into another concave surface, terminating in a point, which among other names bestowed on it by the Savoyards, is styled "Dome de Goute," and may be regarded as the inferior dome.

The first successful attempt to reach the summit of Mont Blanc was made in August 1786, by Doctor Paccard, a physician of Chamouni. He was led to make the attempt by a guide, named Balma, who in searching for crystals, had discovered the only practicable route by which so arduous an undertaking could be accomplished. The ascent occupied fifteen hours, and the descent five, under circumstances of the greatest difficulty, the sight of the Doctor, and that of his guide, Balma, being so affected by the snow

and wind, as to render them almost blind, at the same time that the face of each was excoriated, and the lips exceedingly swelled.

On the first of August of the following year, 1787, the celebrated and indefatigable naturalist, M. de Saussure, set out on his successful expedition, accompanied by a servant and eighteen guides, who carried a tent and mattresses, together with the necessary accommodations and various instruments of experimental philosophy. The first night they passed under the tent, on the summit of the mountain of La Cote, 4986 feet above "the Priory," a large village in the vale of Chamouni, the journey thither being exempt from trouble or danger, as the ascent is always over turf, or on the solid rock; but above this place it is wholly over ice or snows.

Early next morning they traversed the Glacier of La Cote, to gain the foot of a small chain of rocks, inclosed in the snows of Mont Blanc. The glacier is both difficult and dangerous, being intersected by wide, deep, irregular chasms, which frequently can be passed only by three bridges of snow, which are suspended over the abyss. After reaching the ridge of rocks, the tract winds along a hollow, or valley, filled with snow, which extends north and south to the foot of the highest summit, and is divided at intervals by enormous crevices. These shew the snow to be disposed in horizontal beds, each of which answers to a year, and notwithstanding the width of the fissures, the depth can in no part be measured. At four in the afternoon, the party reached the second of the three great platforms of snow they had to traverse, and here they encamped at the height of 9312 feet above the Priory, or 12,768 feet, nearly two miles and a half above the level of the sea.

From the centre of this platform, enclosed between the farthest summit of Mont Blanc on the south, its high steps, or terraces, on the east, and the Dome de Goute on the west, nothing but snow appears. It is quite pure, of a dazzling whiteness, and on the high summits presents a singular contrast with the sky, which in these elevated regions is almost black. Here no living being is to be seen; no appearance of vegetation; it is the abode of cold and silence. "When," observes M. de Saussere, "I represent to myself Dr. Paccard and James Balma first

arriving, on the decline of day, in these deserts, without shelter, without assistance, and even without the certainty that men could live in the places which they proposed to reach, and still pursuing their career with unshaken intrepidity, it seems impossible to admire too much their strength of mind and their courage."

The company departed, at seven the next morning, to traverse the third and last platform, the slope of which is extremely steep, being in some places thirty-nine degrees. It terminates in precipices on all sides; and the surface of the snow was so hard, that those who went foremost were obliged to cut places for the feet with hatchets. The last slope of all presents no danger; but the air possesses so high a degree of rarity, that the strength is speedily exhausted, and on approaching the summit it was found necessary to stop at every fifteen or sixteen paces to take breath. At eleven they reached the top of the mountain, where they continued four hours and a half, during which time M. de Saussure enjoyed, with rapture and astonishment, a view the most extensive as well as the most rugged and sublime in nature, and made those observations which have rendered this expedition important to philosophy.

A light vapour, suspended in the lower regions of the air, concealed from the sight the lowest and most remote objects, such as the plains of France and Lombardy; but the whole surrounding assemblage of high summits appeared with the greatest distinctness.

M. de Saussure descended with his party, and the next morning reached Chamouni, without the smallest accident. As they had taken the precaution to wear veils of crape, their faces were not excoriated, nor their sight debilitated. The cold was not found to be so extremely piercing as it was described by Dr. Paccard. By experiments made with the hygrometer on the summit of the mountain, the air was found to contain a sixth portion only of the humidity of that of Geneva; and to this dryness of the air M. de Saussure imputes the burning thirst which he and his companions experienced. The balls of the electrometer diverged three lines only, and the electricity was positive. It required half an hour to make water boil, while at Geneva fifteen or sixteen minutes sufficed, and twelve or thirteen at the sea side. Not any of the party discovered

the smallest difference in the taste or smell of bread, wine, meat, fruits, or liquors, as some travellers have pretended is the case at great heights; but sounds were of course much weakened, from the want of objects of reflection. Of all the organs, that of respiration was most affected, the pulse of one of the guides beating ninety-eight times in a minute, that of the servant one hundred and twelve, and that of M. de Saussure one hundred and one; while at Chamouni the pulsations respectively were forty-nine, sixty, and seventy-two. A few days afterwards, Mr. Beaufoy, an English gentleman, succeeded in a similar attempt, although it was attended with greater difficulty, arising from enlargements in the chasms in the ice.

THE GLACIERS, OR ICE MASSES.

[*See Plate, No*, 17.]

The three great Glaciers, or Ice mountains, which descend from the flanks of Mont Blanc, add their ice to that of the Miage, and present a majestic spectacle, amid the astonishing succession of icy summits, of deep vallies, and of wide chasms, which have become channels for the innumerable torrents and cataracts with which these mountains abound. The view which the Glacier of Talafre affords from its centre, looking towards the north, is as extraordinary as beautiful. It rises gradually to the base of a semicircular girdle, formed of peaks of granite of a great height, and terminating in sharp summits, extremely varied in their forms; while the intervals between these peaks are filled up by ice, which falls into this mass, and this mass of ice is crowned by masses of snow, rising in festoons between the black and vertical tables of granite, the steepness of which does not allow them to remain. A ridge of shattered wrecks divides this glacier lengthwise, and forms its most elevated part, being 8538 feet, upwards of a mile and a half, above the level of the sea. This prospect has nothing in common with what is seen in other parts of the world. The immense masses of ice, surrounded and surmounted by pyramidal rocks, still more enormous in magnitude; the contrast between the whiteness of the snow and the obscure colours of the stones, moistened by the water which trickles down their sides; the purity of the air; the dazzling light of the sun, which gives to these

objects extraordinary brilliancy, the majestic and awful silence which reigns in these vast solitudes—a silence which is only interrupted at intervals by the noise of some great mass of granite, or of ice, tumbling from the top of the mountain; and the nakedness of these elevated rocks themselves, on which neither animals, shrubs, nor verdure are to be seen, combined with the recollection of the fertile country and rich vegetation which the adjacent vallies at so small a distance present; tend to produce a mixed impression of admiration and terror, which tempts the spectator to believe, that he has been suddenly transported into a world forgotten by the great Author of nature.

The glacier of Triolet is covered with the wrecks of another ice-mountain, which fell some years ago, and buried many huts, flocks, and shepherds beneath its ruins.

VIEW FROM THE BUET.

Before we take our leave of Mont Blanc and of the Alps, the peculiarly brilliant view from the summit of the Buet ought to be noticed. Never, says M. Bourrit, did prospect appear so vast. Towards the west the Rhone is seen, winding for the space of thirty-six leagues through the rich plains of the Valais; the parts of the river which the mountains cover with their shade seeming like threads of silver and those which the sun illumines like threads of gold. Beyond the river and its rich plains, the view extends to the highest mountains of Switzerland, St. Gothard, and the Grisons all covered with ice; while on the east, the heights sink suddenly, from some of the loftiest elevations on the globe, to level plains washed by the sea. Geneva seems like a spot at one end of the lake, and the lake itself like a sinuous band, dividing the fields which it waters. Beyond it are discovered the vast plains of Franche Comte and Burgundy, the mountains of which diminish by almost imperceptible gradations. Here the eye has neither power nor extent of sight to embrace the whole of the objects presented to its view. Amid the fearful aspect of the precipices which descend on every side, what a contrast between the country decorated with all that is smiling and gay, and the sublime spectacle of the Alps, their gloomy and aspiring summits, and, above all, the prodigious height

of Mont Blanc, that enormous colossus of snow and ice, which parts the clouds, and pierces to the very heavens! Below this mountain, which bids defiance to time, and whose eternal ice disregards the dissolving power of the sun, a band of pyramidical rocks appears, the intervals between them being so many vallies of ice, the immensity of which appals the imagination. Their deep chasms may be distinguished, and the noise of the frequent *avalanches* (falls of immense masses of snow,) presents to the mind the gloomy ideas of horror, devastation, and ruin. Farther on, other summits of ice prolong this majestic picture.—Among these are the high mountains of the St. Bernard, and those which border on the Boromean islands.

Perhaps there is not in our hemisphere a theatre more instructive, or more adapted for reflection, than the summit of this mountain. Where beside can be seen such variety and contrast of forms; such results of the efforts of time; such effects of all the climates, and of all the seasons? At one glance may be embraced frosts equally intense with those of Lapland, and the rich and delightful frontiers of Italy; eternal ice, and waving harvests; all the chilling horrors of winter, and the luxuriant vegitation of summer; eighty leagues of fertile plains, covered with towns, with vineyards, with fields, and herds, and adjoining to these, a depth of twenty thousand feet of everlasting ice.

MONTSERRAT.

[*See Plate, No.* 18.]

Here, 'midst the changeful scenery, ever new,
Fancy a thousand wond'rous forms descries,
More wildly great than ever pencil drew;
Rocks, torrents, gulfs, and shapes of giant size,
And glittering cliffs on cliffs, and fiery ramparts rise.

BEATTIE.

THIS Spanish mountain, which has been so long celebrated on account of the singularity of its shape, but chiefly for its convent and its numerous hermitages, is nine leagues north-west of Barcelona, in the province of Catalonia. It is in height only 3,300 feet above the level of the sea, but it commands an enchanting prospect of the fine plain of Barcelona, extending to the sea, as well as of the Islands of Majorca and Minorca, distant 150 miles.

Towards Barcelona this mountain presents a bold and rugged front; but on the west, towards Vacarisas, it is almost perpendicular, notwithstanding which, a carriage-road winds round to the convent, which is placed in a sheltered recess among the rocks, at about half the height of the mountain. The Llobregat roars at the bottom; and the rock presents perpendicular walls from the edge of the water: but above the convent, the mountain divides into two crowns or cones, which form the most prominent features; while smaller pinnacles, blanched and bare, and split into pillars, pipes, and other singular shapes, give a most picturesque effect. Here are seen fourteen or fifteen hermitages, which are scattered over different points of the mountain, some of them on the very pinnacles of the cones, to which they seem to grow, while others are placed in cavities hewn out of the loftiest pyramids. The highest accessible part of the mountain is above the hermitage of St. Maddelena, the descent from which is between two cones, by a flight of steps, called Jacob's Ladder, leading into a valley which runs along the summit of the mountain. The cones are here in the most grotesque shapes, the southern one being named "the Organ," from its resemblance to a number of pipes.

At the extremity of this valley, which is a perfect shrubbery, and on an eminence, stands the hermitage of St. Jerome, the highest and most remote of all; and near it is the loftiest station of the whole mountain, on which is a little chapel dedicated to the Virgin. From this elevated pinnacle the prospect is vast and splendid.

Although the elements have wreaked all their fury on these shattered peaks, yet nature has not been sparing in her gifts; the spaces between the rocks being filled up with close woods, while numerous evergreens, and other plants, serve to adorn the various chasms, rendering them valuable depositories of the vegitable kingdom. Few, indeed are the evergreens of Europe which may not be found here; and when the mountain was visited by Mr. Swinburne, the apothecary of the convent had a list of four hundred and thirty-seven species of plants, and forty of trees, which shoot up spontaneously, and grace this hoary and venerable pile. There being two springs only on the mountain, there is a scarcity of water, which is chiefly collected in

cisterns; an inconvenience, however, which is in a great measure counterbalanced by the absence of wolves, bears, and other wild beasts.

Captain Carlton, an Englishman, who visited Monserrat some years ago, ascended to the loftiest hermitage, that of St. Jerome, by the means of spiral steps hewn out in the rock on account of the steep aclivity. This, he observes could not, in his time be well accomplished by a stranger, without following the footsteps of an old ass, who carried from the convent a daily supply of food to the hermits. This animal having his two panniers stored with the provisions divided into portions, climbed without a guide, and having stopped at each of the cells, where the hermit took the portion allotted to him, returned back to the convent. He found that one of these hermits, to beguile the wearisomeness of his solitude, had contrived so effectually to tame the birds which frequented the groves surrounding his hermitage, that he could draw them together with a whistle, when they perched on his head, breast, and shoulders, taking the food from his mouth.

The convent is situated on the eastern side of the mountain, which seems to have been split by vast torrents of water, or by some violent convulsion of nature: in this way a platform has been formed in the cleft, sufficiently ample for the purpose of its construction. It is one of the forty-five religious houses of the Spanish congregation of the order of St. Benedict. The monks are bound to supply food and lodging for three days to all pilgrims who come up to pay their homage to the Virgin; besides which, they entertain the hermits on Sundays. The latter, who make a vow never to quit the mountain, take their stations by seniority, the junior hermit being placed at the greatest distance from the convent, and descending progressively as the vacancies happen. They are not altogether idle, taking pains to rival each other in making basket-works and other fanciful productions, which they display with great affability to their visitors. They assemble every morning to hear mass and perform divine service, in the parish-church of St. Cecilia, which lies considerably above the convent; and twice a week they confess and communicate. They wear their beards long, and are clad in brown.

The church of St. Cecilia is a gloomy edifice, the gilding



No. 16.—Mount Blanc.



No. 17. Glaciers of Miage.

of which is much sullied by the smoke of eighty-five silver lamps, of various forms and sizes, suspended round the cornice of the sanctuary. For the supply of these with oil, funds have been bequeathed by devotees. The choir is decorated with wood carvings, curiously wrought, representing the most prominent passages in the life of Christ.

THE PEAK OF TENERIFFE.

[*See Plate No. 3.*]

The Island of Teneriffe has received its present name from the inhabitants of the adjacent island Palma, in whose language *tener* signifies snow, and *iffe*, a hill. In extent, wealth, and fertility, it exceeds all the other Canary islands. It continues to rise on all sides from the sea, until it terminates in the celebrated Peak, which is, however, situated rather in the southern part than in the centre of the island. The ascent on the north side is more gradual than at the other parts, there being a space along the shore about three leagues in breadth, bounded on the sides by high mountains, or rather cliffs; but more inland it rises like a hanging garden all the way, without any considerable interruption of hills or vallies. The form of this island is triangular, extending itself into three capes, the nearest of which is about eighty leagues from the coast of Africa. In the middle it is divided by a ridge of mountains, which have been compared to the roof of a church, the Peak forming the spire or steeple in the centre.

The elevation of the Peak of Teneriffe, according to the most accurate measurement, made by Cordier, is 12,166 feet, nearly two miles and one-third above the level of the sea. In the ascent, the first eminence is called Monte Verde, or the green mountain, from the high fern with which it is covered, and presents a level plain of considerable extent. Beyond this is the Mountain of Pines, which are said to have formerly grown there in great abundance; but its steep sides are now become craggy and barren, and its whole appearance very different from that of the eminence described above. After passing this summit, the traveller reaches a plain, on which the natives have bestowed the name of Mouton de Trigo, and upon which the peak in reality stands. It is a mountainous platform, rising more

than seven thousand feet, nearly a mile and a half, above the level of the sea; and here the currents of lava, hitherto concealed by the vegetation, begin to appear in all their aridity and confusion, a few lowly shrubs and creeping plants alone diversifying the surface of a desert, the most arid and rugged that can be imagined.

A small sandy platform of pumice stones, bordered by two enormous currents of vitreous lava, and blocks of the same nature, ranged in a semicircle, forms what is called the Station of the English, on account of the Peak having been so often visited by British travellers. This platform is 9,786 feet, upwards of a mile and three quarters, above the level of the sea; and beyond it the acclivity is very steep, great masses of scoriæ, extremely rough and sharp, covering the currents of lava. Towards the summit, nothing but pumice stone is to be seen. In fact the peak can only be ascended on the east and south-east sides. As it is impossible to get round the crater, the traveller's progress is arrested at the spot at which he reaches it. Here the two orders of volcanic substances are to be seen, the modern lavas being thrown up amid the ruins of ejections much more ancient, the immense masses of which constitute the platform on which the Peak is placed. The shattered sides present a series of thick beds, almost all plunging towards the sea, composed alternately of ashes, volcanic sand, pumice stones, lavas, either compact or porous, and scoriæ. An incalculable number of currents, comparatively recent, which have descended from the Peak, or have issued from its flanks, form irregular furrows, which run along the more ancient masses, and lose themselves in the sea to the west and north. Among these currents more than eighty craters are scattered, and augment with their ruins the confusion which prevails throughout.

The crater can alone be reached by descending down three chasms. Its sides are absolutely precipitous within, and are most elevated towards the north. Its form is elliptical; its circumference about one thousand two hundred feet; and its depth according to Cordier, one hundred and ten feet. Humboldt, however, estimates it at not more than from forty to sixty feet. The sides are, agreeably to the former of these observers, formed of an earth of snowy whiteness, resulting from the decomposition of the blackest

and hardest vitreous porphyritic lava. All the rest is solid, and the lowest part occupied by blocks, which have fallen down from the sides. These solid parts are covered with shining chrystals of sulphur, of a rhomboidal and octoedral figure, some of which are nearly an inch high, and are, perhaps, the finest specimens of native volcanic sulphur yet known. Vapours issue in abundance from among these blocks, and from an infinity of fissures which preserve a very intense heat. These vapours consist solely of sulphur and water, perfectly insipid. Beside the incrustations of sulphur, opal, in thin plates, is formed with great celerity. Humboldt regards the Peak of Teneriffe as an enormous basaltic mountain, resting upon a dense secondary calcareous stone.

Various travellers have asserted, that the cold is intensely keen on the summit of the Peak; that respiration is difficult; and that, particularly, spirituous liquors lose all their strength; which latter circumstance they ascribe to the spirit being more or less exposed to the sulphureous fumes exhaled from the crater. Cordier, and several other accurate observers, declare, however, that neither the smell nor the strength of liquids appeared, at this elevation, to be in the least degree impaired; and that volatile alkali, ether, and spirit of wine, possessed their usual pungency. They add, that the cold is very supportable; and that neither the aqueous sulphureous vapours, nor the rarity of the air, render breathing difficult.

We extract the following interesting particulars from Humboldt's account of his visit to Teneriffe.

"Towards three in the morning, by the sombrous light of a few fir torches, we began our expedition for the summit of the Piton. We scaled the volcano on the north-east, where the declivities are extremely steep; and came, after two hours' toil, to a small plain, which, on account of its isolated situation, bears the name of Alta Vista. It is the station also of the Neveros—those natives, whose occupation it is to collect ice and snow, which they sell in the neighbouring towns. Their mules, better practised in climbing mountains than those hired by travellers, reach Alta Vista, and the Neveros are obliged to transport the snow to this place on their backs. Above this point the Malpays begins; a term by which is designated here, as

well as in Mexico, Peru, and every other country subject to volcanoes, a ground destitute of vegetable mould, and covered with fragments of lavas.

"We observed, during the twilight, a phenomenon which is not unusual on high mountains, but which the position of the volcano we were scaling rendered very striking. A layer of white and fleecy clouds concealed from us the sight of the ocean, and the lower region of the island. This layer did not appear above one thousand six hundred yards high; the clouds were so uniformly spread, and kept so perfect a level, that they wore the appearance of a vast plain covered with snow. The colossal pyramid of the Peak, the volcanic summits of Lanzerota, of Fortaventura, and the isle of Palma, were like rocks amidst this vast sea of vapours, and their black tints were in fine contrast with the whiteness of the clouds."

By an astronomical observation, made at the above elevation at sun-rise, it was ascertained that the true horizon, that is, a part of the sea, was distant one hundred and thirty miles. Our traveller proceeds thus:

"We had yet to scale the steepest part of the mountain, the Piton, which forms the summit. The slope of this small cone, covered with volcanic ashes, and fragments of pumice stone, is so steep, that it would have been almost impossible to reach the top, had we not ascended by an old current of lava, the wrecks of which have resisted the ravages of time. These wrecks form a wall of scorious rocks, which stretches itself into the midst of the loose ashes. We ascended the Piton by grasping these half decomposed scoriæ, the sharp edges of which remained often in our hands. We employed nearly half an hour to scale a hill, the perpendicular height of which does not exceed five hundred feet.

"When we gained the summit of the Piton, we were surprised to find scarcely room enough to seat ourselves conveniently. The west wind blew with such violence that we could scarcely stand. It was eight in the morning, and we were frozen with cold, though the thermometer kept a little above the freezing point.

"The wall, which surrounds the crater like a parapet, is so high, that it would be impossible to reach the Caldera, if on the eastern side there was not a breach, which





No. 18.—*Montserat.*



No. 20.—*Snowden.*

seems to have been the effect of a flowing of very old lava. We descended through this breach towards the bottom of the tunnel, the figure of which is elliptical. The greatest breadth of the mouth appeared to us to be three hundred feet, the smallest two hundred feet.

"We descended to the bottom of the crater on a train of broken lava, from the eastern breach of the enclosure. The heat was perceptible only in a few crevices, which gave vent to aqueous vapours, with a peculiar buzzing noise. Some of these funnels or crevices are on the outside of the enclosure, on the external brink of the parapet that surrounds the crater. We plunged the thermometer into them, and saw it rise rapidly to 68 and 75 degrees.

"We prolonged in vain our stay on the summit of the Peak, to wait the moment when we might enjoy the view of the whole of the Archipelago of the Fortunate Islands. We discovered Palma, Gomera, and the Great Canary, at our feet. The mountains of Lanzerota, free from vapours at sun-rise, were soon enveloped in thick clouds. On a supposition only of an ordinary refraction, the eye takes in, in calm weather, from the summit of the volcano, a surface of the globe of five thousand seven hundred square leagues, equal to a fourth of the surface of Spain.

"Notwithstanding the heat we felt in our feet on the edge of the crater, the cone of ashes remains covered with snow during several months in the winter. It is probable, that under the cap of snow considerable hollows are found, like those we find under the glaciers of Switzerland, the temperature of which is constantly less elevated than that of the soil on which they repose. The cold and violent wind which blew from the time of sun-rise, engaged us to seek shelter at the foot of the Piton. Our hands and faces were frozen, while our boots were burnt by the soil on which we walked. We descended in the space of a few minutes the Sugar-Loaf, which we had scaled with so much toil; and this rapidity was in part involuntary, for we often rolled down on the ashes. It was with regret that we quitted this solitary place, this domain where nature towers in all her majesty."

To the above we subjoin the following extract from the account published in the first volume of the Transactions of the Geological Society, by the Hon. Mr. Bennet.

At the distance of thirty-four leagues from the island, Mr. Bennet had a very distinct view of the Peak, rising like a cone from the bed of the ocean. The rocks and strata of Teneriffe, he observes, are wholly volcanic, the long chain of mountains, which may be termed the central chain, traversing the island from the foot of the second region of the Peak, and sloping down on the eastern, western, and northern sides, to the sea. Towards the south, or more properly the S. S. W. the mountains are nearly perpendicular, and though broken into ridges, and occasionally separated by deep ravines, that are cut transversely as well as longitudinally, there are none of those plains, nor that gradual declination of strata, which the south-eastern and north-western sides of the island exhibit.

Mr. Bennet ascended the Peak in the month of September, 1810. We give the abridged details of this expedition in his own words.

The road to the city of Orotava, is a gradual and easy slope for three or four miles, through a highly cultivated country. Leaving the town, after a steep ascent of about an hour, through a deep ravine, we quitted the cultivated part, and entered into forests of chesnuts, the trees of which are of a large size. The form of this forest is oblong; the soil is deep, and formed of decomposed lava, small ash and pumice. I examined several channels in the strata, or ravines worn by the rains, and there was no appearance of any other rock. Leaving this forest, the tract passes over a series of green hills, which we traversed in about two hours, and at last halted to water our mules at a spot where there is a small spring of bad and brackish water issuing from a lava rock. The ravine is of considerable depth. The range of green hills extending a mile or two further, the soil shallowing by degrees, until at length, the trees and shrubs gradually dwindling in size, the Spanish broom alone covers the ground. Leaving behind us this range of green hills, the track, still ascending, leads for several hours across a steep and difficult mass of lava rock, broken here and there into strange and fantastic forms, worn into deep ravines, and scantly covered in places by a thin layer of yellow pumice. As we proceeded on our road, the hills on our left gradually rose in height till the summits were lost in those of the central chain; while, on our right,

we were rapidly gaining an elevation above the lower range of the Peak. We met with several small conical hills, or mouths of extinct volcanoes, the decomposed lava on the edges of the craters having a strong red ochreous tint. At length, an immense undulated plain spreads itself like a fan, on all sides, nearly as far as the eye can reach. This plain is bounded on the west south-west, and south south-west, by the regions of the Peak; and on the east and north-east, by a range of steep perpendicular precipices and mountains, many leagues in circumference, called by the Spaniards *Las Faldas*. On this plain, or desert, for we had long left all show of vegetation, except a few stunted plants of Spanish broom, a sensible change was felt in the atmosphere: the wind was keen and sharp, and the climate like that of England in the months of Autumn. All here was sad, silent and solitary. We saw at a distance the fertile plains on the coast, lying as it were under our feet, and affording a cheerful contrast to the scenes of desolation with which we were surrounded; we were already seven or eight thousand feet above the level of the sea, and had reached the bottom of the second region of the Peak. . .

Having reached the end of the plain, we found ourselves at the bottom of a steep hill, at the foot of which is a mass or current of lava. After a laborious, not to say hazardous, ascent of about an hour, the pumice and ash gave way, and the mules sinking knee deep at every step, we arrived at about five in the afternoon at the other extremity of the stream of lava, which, descending from the summit of the second region of the Peak, divides at the foot of the cone into two branches, the one running to the north-east, and the other to the north-west. It was here we were to pass the night; so, lighting a fire made of dry branches of the Spanish broom, and stretching a part of a sail over a portion of the rock, we ate our dinner and laid ourselves down to sleep. I however past the best part of the night by the fire, the weather being piercingly cold. As I stood by the fire, the view all around me was wild and terrific, the moon rose about ten at night, and, though in her third quarter, gave sufficient light to shew the waste and wilderness by which we were surrounded. The Peak and the upper regions which we had yet to ascend, towered awfully above our heads, while, below, the mountains that had appeared of

such a height in the morning, and had cost us a day's labour to climb, lay stretched as plains at our feet; from the uncommon rarity of the atmosphere, the whole vault of heaven appeared studded with innumerable stars, while the valleys of Orotava were hidden from our view by a thin veil of light fleecy clouds, that floated far beneath the elevated spot we had chosen for our resting-place; the solemn stillness of the night was only interrupted by the crackling of the fire round which we stood, and by the whistling of the wind, which coming in hollow gusts from the mountain, resembled the roar of distant cannon.

Between two and three in the morning we resumed, on foot, our ascent of the mountain, the lower part of which we had climbed on horseback the preceding evening; the ascent, however, became much more rapid and difficult, our feet sinking deep in the ashes at every step. From the uncommon sharpness of the acclivity, we were obliged to stop often to take breath; after several halts, we at last reached the head of the pumice hill. After resting some short time here, we began to climb the stream of lava, stepping from mass to mass. The ascent is steep, painful, and hazardous; in some places the stream of lava is heaped up in dykes or embankments; and we were obliged to clamber over them as one ascends a steep wall.

We halted several times during the ascent, and at last reached a spot called La Cueva, one of the numerous caves that are found on the sides of the mountain; this is the largest of them, and is filled with snow and the most delicious water, which was just at the point of congelation. The descent into it is difficult, it being thirty or forty feet deep. One of our party let himself down by a rope: he could not see the extent of the cave, but the guides declared it to be three hundred feet in length, and to contain thirty or forty feet of water in depth. The roof and sides are composed of a fine stalactitic lava, similar to that found on Vesuvius, and it is of the same nature as that which flowed on the surface. We rested here about half an hour, during which we had an opportunity of observing the rising of the sun, and that singular and rapid change of night into day, the consequence of an almost entire absence of twilight. As we ascended the north-east side of the mountain, this view was strikingly beautiful: at

first there appeared a bright streak of red on the horizon, which gradually spread itself, lighting up the heavens by degrees, and growing brighter and brighter, till at last the sun burst forth from the bed of the ocean, gilding as it rose the mountains of Teneriffe, and those of the great Canary; in a short time the whole country to the eastward lay spread out as a map. The great Canary was easily to be distinguished; and its rugged and mountainous character, similar to that of the other islands, became visible to the naked eye. The cold at this time was intense, the wind keen and strong, and the thermometer sunk to 32 degrees. After a short though rapid ascent, we reached the summit of the second stage of the mountain, passing over a small plain of white pumice, on which were spread masses of lava, and at length arrived at the foot of the cone. This division of the mountain forms what is generally termed the *Peak of Teneriffe*: it represents the present crater of Vesuvius, with this difference, however, that while the surface of that mountain is composed of a black cinder or ash, the superfices of this appears to be a deposit of pumice of a white colour, of scoriæ and lava, with here and there considerable masses that were probably thrown out when the volcano was in action. Numerous small cavities on the side of the mountain emitted vapour with considerable heat. Here begins the only fatiguing part of the ascent; the steepness of the cone is excessive; at each step our feet sunk into the ash, and large masses of pumice and lava rolled down from above; we were all bruised, and our feet and legs were cut, but not materially hurt: at last we surmounted all difficulties, and seated ourselves on the highest ridge of the mountain. This uppermost region does not appear to contain in superficies more than acre and a half, and is itself a small crater, the walls of which are the different points on which we sat, and are plainly visible from below. Within, the lava is in the most rapid state of decomposition. The surface is hot to the feet, and the guides said it was dangerous to remain long in one spot; as it was, some of us sunk to our knees in the hot deposit of sulphur; upon striking the ground with the feet, the sound is hollow, similar to what is produced by the same impulsion on the craters of *Vesuvius*, and *Solfaterra*. I estimate the depth of the crater to be, from the highest

ridge to the bottom, about two hundred feet, forming an easy and gradual descent.

The view from the summit is stupendous: we could plainly discover the whole form of the island, and we made out distinctly three or four of the islands, which, collectively, are called the Canaries; we could not, however see, *Lancerotte* or *Fuerteventura*, though we were told that other travellers had distinguished them all.

From this spot, the central chain of mountains that runs from south-west to north-east, is easily to be distinguished. These, with the succession of fertile and woody vallies, commencing from *San Ursula*, and ending at Las Horcas, with the long line of precipitous lava rocks that lay on the right of our ascent, and which traverse that part of the island running from east to west, from their point of departure at the *Canales* to where they end in an abrupt headland on the coast, with their forests, and villages, and vineyards, the port with the shipping in the roads, the towns of Orotava with their spires glittering as the morning sun burst upon them, afford a cheerful contrast to the streams of lava, the mounds of ash and pumice, and the sulphurated rock on which we had taken our seat. The sensation of extreme height was in fact one of the most extraordinary I ever felt; and though I did not find the pain in my chest arising from the rarity of the atmosphere, near so acute as on the mountains of Switzerland, yet there was a keenness in the air, independent of the cold, that created no small uneasiness in the lungs. The respiration became short and quick, and repeated halts were found necessary. The idea also of extreme height was to me more determinate and precise than on the mountains of Switzerland; and though the immediate objects of vision were not so numerous, yet as the ascent is more rapid, the declivity sharper, and there is here no mountain like Mont Blanc towering above you, the 12,000 feet above the level of the sea appeared considerably more than a similar elevation above the lake of Geneva. We remained at the summit about three quarters of an hour, our ascent having cost us the labour of four hours, as we left the Estancia at ten minutes before three, and reached the top of the peak before seven. Our thermometer, which was graduated to the scale of Fahrenheit, was, during our ascent, as follows:

at Orotava, at eight in the morning, 74°; at six in the evening, at La Estancia, 50°; at one, in the following morning, 42°; at La Cueva, at half past four, 32°; at the bottom of the cone, 36°; at the top of the peak, one hour and a half after sunrise, 33°. The descent down the cone is difficult from its extreme rapidity, and from the fall of large stones, which loosen themselves from the beds of pumice. Having at last scrambled to the bottom, we pursued our march down the other course of the lava, that is to say, down its westerly side, having ascended its eastern. The ravines and rents in this stream of lava are deep and formidable; the descent into them is always painful and troublesome, often dangerous: in some places we let ourselves down from rock to rock. I can form no opinion why there should be these strange irregularities in the surface of this lava; in places it resembles what sailors term the trough of the sea, and I can compare it to nothing but as if the sea in a storm had by some force become on a sudden stationary, the waves retaining their swell. As we again approached *La Cueva*, we came to a singular steep valley, the depth of which, from its two sides, cannot be less than one hundred to one hundred and fifty feet, the lava lying in broken ridges one upon the other, similar to the masses of granite rock that time and decay have tumbled down from the top of the Alps; and, except from the scoriæ, or what Milton calls "the Fiery Surge," they in no degree bear the marks of having rolled as a stream of liquid matter.

We descended the pumice hill with great rapidity almost at a run, and arrived at La Estancia in little more than two hours. We then mounted our mules, and following the track by which we had ascended the preceding day, we reached, about four o'clock, the country house of our hospitable friend Mr. Barry.

The first eruption of which there is any distinct account, occurred on the 24th of December, 1704, when twenty-nine shocks of an earthquake were distinctly felt. On the 31st a great light was observed on Manja, towards the white mountains. Here the earth opened, and two volcanoes were formed, which threw up such heaps of stones as to raise two considerable mountains: the combustible matter, which still continued to be thrown up, kindled above fif-

ty fires in the vicinity. The whole country for three leagues round was in flames, which were increased by another volcano opening by at least thirty different vents within the circumference of half a mile. On the 2nd of February following, another volcano broke out in the town of Guimar, swallowing up a large church.

A subsequent eruption in 1706 filled up the port of Guarachico. The lava, in its descent, ran five leagues in six hours; and on this lava houses are now built where ships formerly rode at anchor. Neither of these eruptions were from the crater on the summit of the peak, for that has not ejected lava for centuries, and it now issues from the flanks only. The last eruption was on the 9th of June, 1798, and was very terrible. Three new mouths opened at the height of 8,130 feet, upwards of a mile and a half above the level of the sea, upon the inclined slope of the base of the Peak towards the S. W. Above this, at the height of 10,240 feet, nearly two miles, M. Cordier found a vast crater nearly four miles and a half in circumference, which he ascertained to be very ancient. Its sides are extremely steep, and it still presents the most frightful picture of the violence of subterraneous fire. The Peak rises from the sides of this monstrous aperture. To the S. W. is the mountain of Cahora, which is said to have become a volcano in 1797. The other mountains of Teneriffe, which tradition reports to have been formerly volcanoes, are Monte Roxo, or the red mountain; several mountains, called the Malpasses, lying to the eastward; and one, (Rejada) in a southern direction. Throughout the whole of the distance between Monte Roxo and the bay of Adexe, according to Mr. Glass, the shore is about 2500 feet, nearly half a mile, in height, and perpendicular as a wall. The southern coast has a much superior elevation, the chain of mountains by which it is bounded being, agreeably to St. Vincent, 8,320 feet, more than a mile and a half, above the level of the sea.

THE SOUFFRIERE MOUNTAIN,

IN THE ISLAND OF ST. VINCENT.

This volcanic mountain, the dreadful eruption of which we are about to describe, is the most elevated and most

northerly of the lofty chain running through the West-India island of St. Vincent. From the extraordinary frequency and violence of the earthquakes, which in 1811, are calculated to have exceeded two hundred, some great movement or eruption was looked for. In the interim the mountain indicated much disquietude; but the apprehension was not so immediate as to restrain curiosity, or to prevent repeated visits to the crater, which had latterly been more numerous than ever. Even on the 26th of April, 1812, the day preceding the eruption, several gentlemen ascended and remained there for some time. Nothing unusual was then remarked, nor any external difference observed, except rather a stronger emission of smoke from the interstices of the conical hill, at the bottom of the crater. To those who have not visited this romantic and wonderful spot, a slight description of it, as it lately stood, is previously necessary.

"About 2000 feet from the level of the sea, on the south side of the mountain, and at rather more than two-thirds of its height, opens a circular chasm, some what exceeding half a mile in diameter, and between 400 and 500 feet in depth. Exactly in the centre of this capacious bowl, rose a conical hill about 260 or 300 feet in height, and about 200 in diameter, richly covered and variegated with shrubs, brushwood, and vines, above half way up, and the remainder covered over with virgin sulphur to the top. From the fissures of the cone and interstices of the rocks, a thin white smoke was constantly emitted, occasionally tinged with a slight bluish flame. The precipitous sides of this magnificent amphitheatre were fringed with various evergreens and aromatic shrubs, flowers, and many alpine plants. On the north and south sides of the base of the cone were two pieces of water, one perfectly pure and tasteless, the other strongly impregnated with sulphur and alum. This lonely and beautiful spot was rendered more enchanting by the singularly melodious notes of a bird, an inhabitant of these upper solitudes, and altogether unknown to the other parts of the island—hence principally called or supposed to be invisible, though it certainly has been seen, and is a species of black-bird.

A century had now elapsed since the last convulsion of the mountain, or since any other elements had disturbed the serenity of this wilderness, besides those which are common

to the tropical tempest. It apparently slumbered in primeval solitude and tranquility, and, from the luxuriant vegetation and growth of the forest, which covered its side from the base nearly to the summit, seemed to discountenance the fact, and falsify the records of the ancient volcano. Such was the majestic, peaceful Souffriere, on April the 27th; but our imaginary safety was soon to be confounded by the sudden danger of devastation. Just as the plantation bell rang at noon on that day, an abrupt and dreadful crash from the mountain, with a severe concussion of the earth, and tremulous noise in the air, alarmed all around it. The resurrection of this fiery furnace was proclaimed in a moment by a vast column of thick, black, ropy smoke, like that of an immense glass-house, bursting forth at once, and mounting to the sky; showering down sand, gritty calcined particles of earth and ashes mixed, on all below. This, driven before the wind towards Wallibou and Morne Ronde, darkened the air like a cataract of rain, and covered the ridges, woods, and cane-pieces with light grey-coloured ashes, resembling snow when slightly covered by dust. As the eruption increased, this continual shower expanded, destroying every appearance of vegetation. At night a very considerable degree of ignition was observed on the lips of the crater; but it is not asserted that there was as yet any visible ascension of flame. The same awful scene presented itself on the following day; the fall of ashes and calcined pebbles still increasing, and the compact, pitchy column from the crater rising perpendicularly to an immense height, with a noise at intervals like the muttering of distant thunder.

On Wednesday, the 29th, all these menacing symptoms of horror and combustion still gathered more thick and terrific for miles around the dismal and half-observed mountain. The prodigious column shot up with quicker motion, dilating as it rose like a balloon. The sun appeared in total eclipse, and shed a meridian of twilight over us, that aggravated the wintry gloom of the scene, now completely powdered over with falling particles. It was evident that the crisis was yet to come—that the burning fluid was struggling for a vent, and labouring to throw off the superincumbent strata and obstructions, which suppressed its torrent. At night, it was manifest that it had greatly disengaged itself from its

burthen, by the appearance of fire flashing above the mouth of the crater.

On the memorable 30th of April, the reflection of the rising sun on this majestic body of curling vapour was sublime beyond imagination: any comparison of the Glaciers, or of the Andes, can but feebly convey an idea of the fleecy whiteness and brilliancy of this awful column of intermingled and wreathed smoke and clouds. It afterwards assumed a more sulphureous cast, like what are called thunder clouds, and in the course of the day had a ferruginous and sanguine appearance, with a much livelier action in the ascent, and a more extensive dilatation, as if almost freed from every obstruction. In the afternoon, the noise was incessant, and resembled the approach of thunder still nearer and nearer, with a vibration that affected the feelings and hearing: as yet there was no convulsive motion, or sensible earthquake. The Charaibs settled at Morne Ronde, at the foot of the Souffriere, abandoned their houses, with their live stock, and every thing they possessed, and fled precipitately towards town. The negroes became confused, forsook their work, looked up to the mountain, and, as it shook, trembled, with the dread of what they could neither understand or describe: the birds fell to the ground, overpowered with showers of ashes, unable to keep themselves on the wing—the cattle were starving for want of food, as not a blade of grass or a leaf was now to be found—the sea was much discoloured, but not uncommonly agitated; and it is remarkable, that throughout the whole of this violent disturbance of the earth, it continued quite passive, and did not at any time sympathize with the agitation of the land. About four o'clock in the afternoon, the noise became more alarming, and just before sun-set the clouds reflected a bright copper colour, suffused with fire. Scarcely had the day closed, when the flames burst at length pyramidically from the crater, through the mass of smoke; the rolling of the thunder became more awful and deafening; electric flashes quickly succeeded, attended with loud claps; and now, indeed, the tumult began. Those only who have witnessed such a sight, can form any idea of the magnificence and variety of the lightning and electric flashes; some forked and zig-zag, playing across the perpendicular column from the crater—others

shooting upwards from the mouth like rockets of the most dazzling lustre—others like shells, with their trailing fuses, flying in different parabolas, with the most vivid scintillations from the dark sanguine column, which now seemed inflexible, and immoveable by the wind. Shortly after seven in the afternoon, the mighty cauldron was seen to simmer, and the ebullition of lava to break out on the N. W. side. This, immediately after boiling over the orifice, and flowing a short way, was opposed by the acclivity of a higher point of land, over which it was impelled by the immense tide of liquefied fire which drove it on, forming the figure V in grand illumination. Sometimes, when the ebullition slackened, or was insufficient to urge it over the obstructing hill, it recoiled like a refluent billow, from the rock, and then again rushed forward, impelled by fresh supplies, and, surmounting every obstacle, carried rocks and woods together, in its course down the slope of the mountain, until it precipitated itself down some vast ravine, concealed from our sight by the intervening ridges of Morne Ronde. Vast globular bodies of fire were seen projected from the fiery furnace, and, bursting, fell back into it, or over it, on the surrounding bushes, which were instantly set in flames. About four hours from the lava boiling over the crater, it reached the sea, as we could observe from the reflection of the fire and electric flashes attending it. About half past one, the following morning, another stream of lava was seen descending to the eastward towards Rabacca. The thundering noise of the mountain, and the vibration of sound that had been so formidable hitherto, now mingled in the sudden monotonous roar of the rolling lava, became so terrible, that dismay was almost turned into despair. At this time the first earthquake was felt; this was followed by showers of cinders, which fell with the hissing noise of hail, during two hours.

"At 3 o'clock, a rolling on the roofs of the houses indicated a fall of stones, which soon thickened, and at length descended in a rain of intermingled fire, which threatened at once the fate of Pompeii, or Herculaneum. The crackling coruscations from the crater at this period exceeded all that had yet passed. The eyes were struck with momentary blindness, and the ears stunned with a confusion of sounds. People sought shelter in the cellars, under rocks,

or any where—for every place was nearly the same; and the miserable negroes, flying from their huts, were knocked down, or wounded, and many killed in the open air. Several houses were set on fire. The estates situated in the immediate vicinity, seemed doomed to destruction. Had the stones which fell been heavy in proportion to their size, not a living creature could have escaped death: these, having undergone a thorough fusion, were divested of their natural gravity, and fell almost as light as pumice, though in some places as large as a man's head. This dreadful rain of stones and fire lasted upwards of an hour, and was again succeeded by cinders from 3 till 6 o'clock in the morning. Earthquake followed earthquake, almost momentarily; or rather the whole of this part of the island was in a state of continued oscillation; not agitated by shocks vertical or horizontal; but undulated like water shaken in a bowl.

The break of day, if such it could be called, was truly terrific. Utter darkness prevailed till eight o'clock, and the birth of May dawned like the day of judgement: a chaotic gloom enveloped the mountain, and an impenetrable haze hung over the sea, with black sluggish clouds of a sulphureous cast. The whole island was covered with cinders, scoriæ, and broken masses of volcanic matter. It was not until the afternoon, that the muttering noise of the mountains sunk gradually into a solemn yet suspicious silence. Such are the particulars of this sublime and tremendous scene, from its commencement to its catastrophe.

THE PEAK OF DERBYSHIRE.

[*See Plate, No. 25.*]

This Peak consists of a chain of high mountains in the County of Derby, and has been long celebrated, as well on account of its mineral productions, and natural curiosities in general, as of what are called its *Seven Wonders*. Six of these are natural, namely, *Poole's Hole*, *Elden Hole*, the *Peak Cavern*, or the *Devil's Hole*, *Mamtor*, *St. Ann's Well*, and the *Ebbing and Flowing Well*. Having described these, we shall add a recent discovery, that of the Crystallized Cavern, which possesses an equal interest.

Poole's Hole lying about a mile to the westward of

Buxton, is a vast cavern formed by nature in the limestone rock, and was, according to tradition, the residence of an out-law, named Poole. The entrance is low and contracted, and the passage narrow; but this widening, at length, leads to a lofty and spacious cavern, from the roof of which stalactites or transparent crystals, formed by the constant dropping of water laden with calcareous matter, hang in spiral masses. Other portions of these petrifactions drop and attach themselves to the floor, rising in cones, and, becoming what are termed *stalagmites*.

One of the dropping stalactites, of an immense size, called the *flitch of bacon*, occurs about the middle of the cavern, which here becomes very narrow, but soon spreads to a greater width, and continues large and lofty until the visitor reaches another surprisingly large mass of stalactite, to which the name of *Mary Queen of Scots' Pillar* is given, from the tradition of that unfortunate queen having paid a visit to the cavern, and proceeded thus far into its recesses. As this pillar cannot be passed without some difficulty few persons venture beyond it; nor does it seem desirable, as, by proceeding thus far, a very competent idea of the cavern may be formed. The path hitherto is along the side, and at some height from the bottom of the cavern; but to visit and examine the interior extremity, it becomes necessary to descend a few yards by very slippery and ill-formed steps. The path at the bottom is tolerably even and level for about sixty feet, when an almost perpendicular ascent commences, which leads to the extremity of the fissure, through the *eye of St. Anthony's needle*; a narrow strait, beyond which the steepness of the way is only to be surmounted by clambering over irregular masses of rock. The cavern terminates at nearly three hundred feet beyond the Queen of Scots' pillar. Towards the end is an aperture through a projecting rock, behind which a candle is generally placed, when any person has reached the extremity: when seen at that distance, it appears like a dim star. The visitor returns along the bottom of the cavern, beneath a considerable portion of the road by which he entered; and, by thus changing the path, has an opportunity better to ascertain the height and width of the cavern in every part, and to view other accumulated petrifactions, some of which are of a prodigious size, and of an extraordinary form. In

one part of this passage is a fine spring of transparent water; and a small stream, which becomes more considerable in rainy seasons, runs through the whole length of the cavern. Its sound, in passing through this spacious and lofty concavity, which resembles the interior of a Gothic cathedral, has a fine effect. To the right, in a small cavern called Poole's chamber, is a curious echo.

The various masses of stalactical matter which are every where met with in this natural excavation, and which reflect innumerable rays from the lights carried by guides, are distinguished by the names of the objects they are fancied most to resemble. Thus we have *Poole's saddle*, his *turtle*, and his *woolsack*; the *lion*, the *lady's toilet*, the *pillion*, the *bee-hive*, &c. It should be noticed, however, that the forms are constantly varied by the percolation of the water through the roof and sides of the rock. The subterraneous passage is nearly half a mile in length.

ELDEN HOLE.

ELDEN HOLE is situated on the side of a gentle hill about a mile to the north-west of the village of Peak Forest. It is a deep chasm in the ground, surrounded by a wall, of uncemented stones, to prevent accidents. This fissure or cleft in the rock has been the subject of many exaggerated descriptions, and superstitious reports, having been represented not only as unfathomable, but as teeming, at a certain depth, with so impure an air, that it could not be respired without immediate destruction. Mr. Lloyd, however, who descended it about fifty years ago, has proved the absurdity of these relations, in a paper, of which the following is a brief abstract, published in the Philosophical Transactions.

For the first sixty feet he observes, he descended somewhat obliquely, the passage then becoming difficult from projecting crags. At the further depth of thirty feet, the inflection of his rope varied at least eighteen feet from the perpendicular. The breadth of the chink was here about nine feet, and the length eighteen; the sides being irregular, moss-grown, and wet. Within forty-two feet of the bottom, the rock opened on the east, and he swung till he reached the floor of a cave, one hundred and eighty-six feet only from the mouth, the light from which was suffi-

ciently strong to permit the reading of any book. The interior of the chasm he describes as consisting of two parts, which communicate with each other by a small arched passage, the one resembling an oven, the other the dome of a glass-house. On the south side of the latter, was a small opening, about twelve feet in length, and four feet in height, lined throughout with a kind of sparkling stalactite, of a fine deep yellow colour, with petrifying drops hanging from the roof. Tracing the entrance he found a noble column, above ninety feet high, of the same kind of incrustation. As he proceeded to the north, he came to a large stone which was covered with the same substance; and beneath it he found a hole six feet in depth, uniformly lined with it. From the edge of this hole sprung up a rocky ascent, sloping, like a buttress, against the side of the cavern, and consisting of vast, solid, round masses of the same substance and colour. Having climbed this ascent to the height of about sixty feet, he obtained some fine pieces of stalactite, which hung from the craggy sides of the cavern. Descending with some difficulty and danger, he proceeded in the same direction, and soon came to another pile of incrustations of a brown colour, above which he found a small cavern, opening into the side of the vault, which he now entered. Here he saw vast masses of stalactite, hanging like icicles from every part of the roof: several of these were four and five feet long, and thick as a man's body. The sides of the largest cavern were chiefly lined with incrustations of three kinds, the first of which was a deep yellow stalactite; the second, a thin coating which resembled a pale stone-colour varnish, and reflected the light of the candle with great splendour; and the third, a rough efflorence, the shoot of which resembled a rose flower.

The authors of a recent publication thus state the result of their observations and inquiries relative to Elden Hole. They describe the mouth of this chasm as opening horizontally, in a direction from north to south; its shape being nearly that of an irregular ellipsis, about ninety feet in length, and twenty seven in breadth at the widest part. The northern end is fringed with small trees; and moss and underwood grow out of the crevices on each side, to the depth of forty or fifty feet. As the fissure recedes from the surface, it gradually contracts; and at the depth of

about seventy feet inclines considerably to the west, so as to prevent its course from being farther traced. Notwithstanding the obstacles of the bushes and projecting masses of stone, it was sounded, and its depth found not to exceed two hundred and two feet—an estimate which corresponds with the assertion of three miners, who had descended in search of the bodies of individuals who were missing, and were supposed to have been robbed, murdered, and thrown into this frightful abyss.

PEAK CAVERN.

Peak cavern, also called the *Devil's* Hole, is one of those magnificent, sublime, and extraordinary productions of nature, which constantly excite the wonder and admiration of their beholders. It has accordingly been considered one of the principal wonders of Derbyshire, and has been celebrated by several poets. It lies in the vicinity of Castleton, and is approached by a path at the side of a clear rivulet, leading to the fissure, or separation of the rock, at the extremity of which the cavern is situated. It would be difficult to imagine a scene more august than that which presents itself to the visitor at its entrance; on each side, the huge grey rocks rise almost perpendicularly, to the height of nearly three hundred feet, or about seven times the height of a modern house, and meeting each other at right or cross angles, form a deep gloomy recess. In front, it is over hung by a vast canopy of rock, assuming the appearance of a depressed arch, and extending, in width, one hundred and twenty feet; in height, forty-two; and in receding depth, about ninety. After penetrating about ninety feet into the cavern, the roof becomes lower, and a gentle descent leads, by a detached rock, to the interior entrance of this tremendous hollow. Here the light of day, having gradually diminished, wholly disappears; and the visitor is provided with a torch to illumine his farther progress.

The progress now becoming extremly confined, he is obliged to proceed, in a stooping posture, about twenty yards, when he reaches a spacious opening, named the Bell-house, and is thence led to a small lake, called the *First Water*, about forty feet in length, but not more than two or three feet in depth. Over this he is conveyed in a boat to

the interior of the cavern, beneath a massive vault of rock, which in some parts descends to within eighteen or twenty inches of the water. "We stood some time," says M. de St. Fond, "on the brink of this lake; and the light of our dismal torches, which emitted a black smoke, reflecting our pale images from its bottom, we almost conceived we saw a troop of spectres starting from an abyss to welcome us. The illusion was extremely striking."

On landing, the visitor enters a spacious vacuity, 220 feet in length 200 feet in breadth, and in some parts 120 feet in height, opening into the bosom of the rock; but, from the want of light, neither the distant sides nor the roof of this abyss, can be seen. In a passage at the inner extremity of this vast cave, the stream which flows through the whole length of the cavern, spreads into what is called the *Second Water*, and near its termination is a projecting pile of rocks, known by the appellation of *Roger Rain's* House, from the incessant fall of water in large drops through the crevices of the roofs. Beyond this, opens another tremendous hollow, called the *Chancel*, where the rocks are much broken, and the sides covered with stalactical or petrified incrustations. Here the visitor is surprised by a vocal concert which bursts in discordant tones from the upper regions of the chasm. "Still," observes a modern tourist, "This being unexpected, and issuing from a quarter where no object can be seen, in a place where all is still as death, is calculated to impress the imagination with solemn ideas, and can seldom be heard without that emotion of awe and pleasure, astonishment and delight, which is one of the most interesting feelings of the mind." At the conclusion of the strain, the choristers, who consist of eight or ten women and children, are seen ranged in the hollow of the rock, about fifty feet above the floor.

The path now leads to a place whimsically called the *Devil's Cellar* and *Half-way House*, and thence, by three natural and regular arches, to a vast concavity, which, from its uniform bell-like appearance, is called *Great Tom of Lincoln*. When illuminated by a strong light, this concavity has a very pleasing effect; the symmetrical disposition of the rocks, the stream flowing beneath, and the spiracles in the roof, forming a very interesting picture. From this

point the vault gradually descends, the passage contracts, and at length does not leave more than sufficient room for the current of the stream, which continues to flow through a subterraneous channel of several miles in extent, as is proved by the small stones brought into it after great rains, from the distant mines of the Peak Forest.

The entire length of this wonderful cavern is 2250 feet, nearly half a mile; and its depth, from the surface of the Peak mountain, about 620 feet. A curious effect is produced by the explosion of a small quantity of gunpowder, wedged into the rock in the interior of the cavern; for the sound appears to roll along the roof and sides, like a tremendous and continued peal of thunder. The effect of the light, on returning from these dark recesses, is particularly impressive; and the gradual illumination of the rocks, which becomes brighter as the entrance is approached, is said to exhibit one of the most interesting scenes that ever employed the pencil of an artist, or fixed the admiration of a spectator.

MAM TOR.

MAM TOR or the SHIVERING MOUNTAIN, is a huge precipice facing the east or south-east, chiefly composed of a peculiar kind of slate, which, although very hard before it is exposed to the air, very easily crumbles to dust on such exposure. Hence it is perpetually wasted by the action of the rain and snow; while the harder and larger masses of stone being thus loosened and disengaged, necessarily fall from their positions, and this with a rushing noise which is occasionally so loud as to be heard at Castleton, a distance of two miles. The valley beneath is overwhelmed with their fragments to the extent of half a mile. In many parts of the precipice, they produce, before their descent, a cavernous appearance, and even a romantic overhanging scenery, highly dangerous to be approached. It is affirmed by the most intelligent of the neighbouring inhabitants, that this mountain chiefly wastes during violent storms of snow and rain; and Mr. Martin, who published an account of Mam Tor, in the Philosophical Transactions for 1729, affirms, that the decay is not constantly the same. He not only surveyed it closely, but ascended the steepest part of the

precipice, without tracing any other shivering in the mountain, beside that which was occasioned by the treading of his feet in the loose crumbled earth.

THE EBBING AND FLOWING WELL.

In the vicinity of Chapel-en-le-Frith is a steep hill, rising to the height of more than a hundred feet, immediately beneath which this natural phenomenon lies. It is of an irregular form, but nearly approaching to a square, from two or three feet in depth, and about twenty feet in width.

Its ebbings and flowings are irregular, and dependent on the quantity of rain which falls in the different seasons of the year; when it begins to rise, the current can only be perceived by the slow movement of the blades of grass, or other light bodies floating on the surface; notwithstanding which, before the expiration of a minute, the water issues with a guggling noise, in considerable quantities, from several small apertures on the south and west sides. The interval of time between the ebbing and flowing is not always alike: consequently the proportion of water it discharges at different periods, also varies. In the space of five minutes flowing, the water occasionally rises to the height of six inches; and, after remaining a few seconds stationary, the well assumes its former quiescent state.

The cause of the intermittent *flowing* of this well may be satisfactorily explained, on the principle of the action of the syphon, and on the supposition of a natural one communicating with a cavity in the hill, where the water may be supposed to accumulate;—but for the phenomenon of its *ebbing*, no satisfactory reason has been assigned. The opinion of a second syphon, as ingenously advanced by a modern Tourist, which begins to act when the water rises, is inconsistent with the appearance of the well, and therefore cannot be just.

ST. ANNE'S WELL.

This Well, the usual resort of the company who frequent Buxton to drink the waters, has been classed among the wonders of the Peak, on account of this singularity—that within five feet of the hot spring by which it is supplied,

a cold one arises. This is not, however, the only well of the kind, since *hot* and *cold* springs rise near each other in many parts of England, and in other countries. The water is conveyed to the well, which is an elegant classical building, in the Grecian style, from the original spring, by a narrow passage, so close and well contrived as to prevent it from losing any considerable portion of its heat, and is received in a white marble bason. It is not so warm as the Bath water, its temperature being about 80 degrees of *Fahrenheit*.

THE CHRYSTALLIZED CAVERN.

The Chrystallized Cavern, the new wonder of the Derbyshire Peak, has been recently discovered in the vicinity of the village of Bradwell. We extract the following particulars of this singular and beautiful natural excavation from Hutchinson's late tour in the High Peak.

The entrance is rather terrific than grand; and the descent for about thirty paces very abrupt. The visitor has then to pass along the inclined way for nearly a quarter of a mile, the opening being so low that it is impossible to proceed, in particular parts, in an erect posture. The different crystallizations which now attract his attention on every side, soon make him forget the irksomeness of the road, and banish every idea of fatigue. New objects of curiosity crowd one on the other: in a place called the *Music Chamber*, the petrifactions take the semblance of the pipes of an organ; while in other parts, these stalactites are formed into elegant small colonnades, with as exact a symmetry as if they had been chiselled by the most skilful artist. Candles judiciously disposed within them give an idea of the imaginary palaces of fairies, or of sylphs and genii, who have chosen this for their magnificent abode.

Still he has seen nothing comparable to what he is now to expect; for, at the distance of about a hundred paces further, by a rugged descent, he enters what is called the *Grotto of Paradise*. This heavenly spot for it cannot be compared to any thing terrestrial, is, of itself, a beautiful crystallized cavern, about twelve feet high, and in length twenty feet, pointed at the top, similar to a gothic arch, with a countless number of large stalactites hanging from the

roof. Candles placed among them give some idea of its being lighted up with elegant glass chandeliers; while the sides are entirely incrusted, and brilliant in the extreme.—The floor is chequered with black and white spar. It has altogether, Mr. Hutchinson observes, the most novel and elegant appearance of any cavern he ever beheld. This glittering apartment would be left by the visitor with a certain degree of regret, did he not expect to see it again on his return.

Still continuing a route similar to the one he has passed, in the course of which his attention is occasionally arrested by the curiosities of the place, and by the gentle droppings of the water, which scarcely break the solemn silence of the scene, he at length reaches the *Grotto of Calypso*, and the extremity of the cavern, upwards of 2000 feet from the entrance. To see this grotto to advantage, he has to ascend about six feet, into a recess. There, the beautiful appearance of the different crystallizations, some of them of an azure cast, and the echoes reverberating from side to side, make him fancy he has reached the secluded retreat of some mythological deity.

Returning by the same path for a considerable distance, another cavern, which branches in a south-west direction from the one already explored, presents itself. The roads here are still more difficult of access, but the stalactites are certainly most beautiful. Many of them, more than a yard in length, are pendent from the roof, and the greater part do not exceed the dimension of the smallest reed.—The top and sides of this cavern are remarkably smooth, particularly at the part called the *Amphitheatre*. In general, the stone is of a very dark colour, to which the transparent appearances before mentioned, with each a drop of water hanging at its extremity, form a fine contrast.

SPEEDWELL LEVEL.

In the Speedwell Level, or Navigation Mine, in the vicinity of Castleton, art has been combined with the subterraneous wonders of nature. Being provided with lights, the guide leads the visitor beneath an arched vault, by a flight of 106 steps, to the *sough* or level, where a boat is ready for his reception, and which is put in motion by

pushing against pegs driven into the wall for that purpose. After proceeding about one third of a mile through various caverns, the level bursts into a tremendous gulf, the roof and bottom of which are invisible, but across which the navigation has been carried, by throwing a strong arch over a part of the fissure where the rocks are least separated. Here, leaving the boat, and ascending a stage erected above the level, the attention of the visitor is directed to the dark recess of the abyss beneath his feet; and firm indeed must be his resolution, if he can contemplate the scene unmoved, and without an involuntary shudder. To the depth of ninety feet all is vacuity and gloom; but beyond that commences a pool of stygian waters, not unaptly named the *bottomless pit*, the prodigious range of which may in some measure be conceived, by the circumstance of its having swallowed up more than 40,000 tons of rubbish, made in blasting the rock, without any apparent diminution either of its depth or extent. The guides assert that the former has not been ascertained; but there is reason to believe that its actual depth in standing water is about 320 feet. There cannot, however, be a doubt but that this abyss has communications with others still more deeply situated in the bowels of the mountain, and into which the precipitated rubbish has found a passage.. The superfluous water of the level falls through a water-gate into this profound caldron, with a noise like a rushing torrent.

This fissure is calculated to be about 800 feet beneath the surface of the mountain; and so great is its reach upward, that rockets of sufficient strength to ascend 450 feet, have been fired without rendering the roof visible. The effect of a Bengal light discharged in this stupendous cavity is extremely magnificent and interesting.

THE HIGH TOR.

This is one of the many sublime objects presented by Matlock Dale, the beauties of which will be cursorily described, in proportion as these objects pass under our review.

In approaching the bath, which is nearly a mile to the south-west of the village of Matlock, a specimen of the

scenery by which this charming vale is distinguished, presents itself. The entrance is through a rock, which has been blasted for the purpose of opening a convenient passage;—and here a scene which blends the constituent principles of the picturesque, the beautiful, and the sublime, opens suddenly on the view. Through the middle of a narrow plain flows the Derwent, overhung by a profusion of luxuriant beeches and other drooping trees. Towards the east are gently rising grounds; and on the west the huge mural banks of the vale stretch along, the white face of the rock of which they are composed occasionally displaying itself through the woody clothing of their sides and summits. This magnificent scenery is singularly contrasted by the manufactories and lodging-houses at the bottom of the vale.

To see this magic spot to the greatest advantage, it should be entered at its northern extremity, its beauties then succeeding each other in a proper gradation, and their grandeur and effect being rendered more impressive. The chief attention is now attracted to the High Tor, a grand and stupendous rock, which appears like a vast abrupt wall of limestone, and rises almost perpendicularly from the river, to the height of upwards of 350 feet. The lower part of this majestic feature is shaded by yew-trees, elms, limes, and underwood of various foliage; but the upper part, for fifty or sixty yards, presents a ruggid front of one broad mass of perpendicular rock. From its summit the vale is seen in all its grandeur, diversified by woods of various hues and species. The windings of the Derwent, the greyish-coloured rocks, and the white fronts of the houses, embosomed amidst groves of trees which sprout from every crevice of the precipices, give variety and animation to a scene of wonderful beauty.

CHEE TOR.

In a romantic and deep hollow, near the little village of Wormhill, the river Wye flows beneath this stupendous mass of rock, which rises perpendicularly more than 360 feet above its level. The channel of the river, which meanders at the base, is confined between huge rocks of limestone, having such a general correspondence of situa-

tion and form, as to render it probable that they were once united. In some parts they are partially covered with brushwood, nut-trees, and mountain-ash; while in others, they are totally naked, precipitous, and impending. The chasm runs in a direction so nearly circular, that the sublime CHEE TOR, and its dependant masses of rock, are almost insulated by the river which rolls at their feet. Its length, as far as it possesses any considerable beauty, is between five and six hundred yards; a distance which presents several picturesque and interesting views, the general effect of the fine scenery being enhanced by the plantations on the neighbouring heights, and by a spring which flows into the river near the bottom of a deep descent. From a particular station in this romantic spot, the four vallies of Wye Dale, Chee Dale, Flag Dale, and Water Dale, may be seen together with the Tor and river.

MASSON HILL.

Where as proud MASSON rises rude and bleak,
And with mis-shapen turrets crests the peak,
Old MATLOCK gapes, with marble jaws beneath,
And o'er scar'd DERWENT bends his flinty teeth;
Deep in wide caves, below the dangerous soil,
Blue sulphurs flame, imprison'd waters boil.
Impetuous streams in spiral columns rise
Through rifted rocks, impatient for the skies;
Or, o'er bright seas of bubbling lavas blow,
As heave and toss the billowy fires below;
Condens'd on high, in wandering rills they glide,
From MASSON's dome, and burst his sparry side;
Round his grey towers, and down his fringed walls,
From cliff to cliff the liquid treasure falls;
In beds of stalactite, bright ores among,
O'er corals, shells, and chrystals, winds along;
Crusts the green mosses, and the tangled wood,
And sparkling plunges to its parent flood.

DARWIN's LOVES OF THE PLANTS.

THIS very high eminence is directly opposite to the HIGH TOR, but rises with a less steep ascent. Its summit is named the *Heights of Abraham*, from its resemblance to the heights of that name near Quebec, rendered so memorable by the enterprise of the gallant Wolfe in 1759. It overlooks the country to a vast extent, so as to command a

view of almost the whole length of the valley. Its considerable elevation above the surrounding objects greatly changes their general size and appearance. Even the HIGH TOR seems considerably diminished in grandeur and sublimity; but this effect is partly compensated by the extent of the prospect, and the variety of objects it comprehends. The height of this eminence is about 750 feet, the path to its summit having been carried, in a winding direction, through a grove. At the one half of its ascent is an alcove, from which an extensive view of a great part of Matlock Dale may be seen, through a fine avenue formed for that purpose.

THE CUMBERLAND CAVERN.

To the west and north-west of the village of Matlock are three apertures in the rock, respectively named the CUMBERLAND, SMEDLEY, and RUTLAND Caverns. The former of these is well deserving of a short notice.

The entrance is partly artificial, to afford a greater facility to the visitor, who has to descend fifty-four steps. The cavern now opens on him in solitary grandeur. Huge masses of stone are piled on each other with a tremendous kind of carelessness, evidently produced by some violent concussion, though at an unknown period. He is conducted to a long and wide passage, the roof of which has all the regularity of a finished ceiling, and is bespangled by spars of various descriptions. From above, from beneath, and from the sides, the rays of the lights are reflected in every direction. In an adjacent compartment rocks are heaped on rocks in terrible array, and assume a threatening aspect. Next is an apartment decorated with what, in the language of the country, is called the *snow fossil*—a petrifaction which, both in figure and colour, resembles snow, as it is drifted by the winter storm into the cavities of a rock. Near the extremity of the cavern are to be seen fishes petrified and fixed in the several strata which form the surrounding recess. One of these has its back *jutting out* of the side of the earth, as if it had been petrified in the act of swimming. In another branch of the cavern a well has been found of a considerable depth.

REYNARD'S HOLE.

After having proceeded about a mile in Dove Dale, the romantic and sublime beauties of which will be hereafter noticed, by a route constantly diversified by new fantastic forms, and uncouth combinations of rock, the visitor is led to a mass of mural rock, bearing the above name, and perforated by nature into a grand-arch, nearly approaching to the shape of the sharply-pointed gothic style of architecture, about forty-five feet in height, and in width twenty. Having passed through this arch, a steep ascent leads to a natural cavern, called Reynard's Hall, forty-five feet in length, fifteen in breadth, and in height thirty. From the mouth of this cavern the scenery is singular, beautiful, and impressive. The face of the rock, which contains the arch rises immediately in front, and would effectually prevent the eye from ranging beyond its mighty barrier, did not its centre open into the above-mentioned arch, through which is seen a small part of the opposite side of the Dale, consisting of a mass of gloomy wood, from the shade of which a huge detached rock, solitary, cragged, and pointed, starts out to a great height, and forms an object truly sublime. This rock which has received the name of Dove Dale Church, is pleasingly contrasted by the little pastoral river, Dove, and by its verdant turfy banks. A narrow opening at the extremity of the cavern is supposed to lead to other similar cavities in the rock; and on the left is a cavern, about forty feet in length, in breadth fourteen, and in height twenty-six, called Reynard's Kitchen, from the interior of which a pleasing view is presented of the upper part of the dale, its river, and rocks.

After passing Reynard's Hole, already described, the rocks rise more abrupt on either side, and appear in shapes more wild and irregular, but diversified and softened by shrubs.

Dove Dale is nearly three miles in length; but from the sinuosity of its course, and its projecting precipices, the views are limited. Throughout the whole of this majestic feature of country, the river Dove flows, in the halcyon days of summer, with soft murmurs, innocently and transparently over its pebbly bed; but swells into rage during the

winter months. Little tufts of shrubs and underwood form islands in miniature within its bed, which enlarge and swell the other objects. The scenery of this Dale is distinguished from almost every other in the United Kingdoms, by the rugged, dissimilar, and frequently grotesque and fanciful appearance of the rocks. To employ the words of a late tourist, "It is, perhaps, on the whole one of the most pleasing sceneries of the kind any where to be met with. It has something peculiarly characteristic. Its detached, perpendicular rocks stamp it with an image entirely its own, and for that reason it affords the greater pleasure.— For it is in scenery as in life. We are most struck with the peculiarity of an original character, provided there be nothing offensive in it."

THOR'S HOUSE.

Where Hamps and Manifold, their cliffs among,
Each in his flinty channel winds along,
With lucid lines the dusky moor divides,
Hurrying to intermix their sister tides,
Where still their silver-bosom'd nymphs abhor
The blood-smear'd mansion of gigantic THOR—
Erst fires volcanic in the marble womb
Of cloud-wrapp'd WHETTON rais'd the massy dome
Rocks rear'd on rocks, in huge disjointed piles,
Form the tall turrets, and the lengthen'd aisles ;
Broad pond'rous piers sustain the roof, and wide
Branch the vast rainbow ribs from side to side.
While from above, descends, in milky streams,
One scanty pencil of illusive beams,
Suspended crags, and gaping gulfs illumes,
And gilds the horrors of the deepen'd glooms,
—Here oft the Naiads, as they chance to stray
Near the dread Fane, on Thor's returning day,
Saw from red alters streams of guiltless blood,
Stain their green reed-beds, and pollute their flood ;
Heard dying babes in wicker prisons wail,
And shrieks of matrons thrill the affrighted gale ;
While from dark caves infernal echoes mock,
And fiends triumphant shout from every rock !

DARWIN.

THIS spacious cavern is situated about two miles above Dove Dale, near the village of Whetton ; and tradition says the Druids here offered human sacrifices, inclosed in wicker idols, to Thor, the principal deity of the Saxons

and Danes, in the ages of their idolatrous worship. Beneath is an extensive and romantic common, where the rivers Hamps and Manifold sink into the earth, and rise again in Islam gardens. These rivers merit a brief description. A wooden bridge has been thrown over an abyss in the rock, out of which the river MANIFOLD bursts with surprising force, after having pursued a subterraneous course of five miles, from the point where it had engulfed itself in the earth, called WESTON HILL. At the further distance of twenty yards a similar phenomenon occurs; for here another fissure of a rock presents itself, whence the river HAMPS throws its water into day. This river disappears at LEEK-WATER HOUSES, a place between LEEK and ASHBOURN; thus pursuing a subterraneous course of seven miles, before it again emerges into light. On their emersion, the temperature of the two rivers differ two degrees and a half, the HAMPS being the coldest.

THE LOVERS' LEAP.

THE environs of Buxton abound in romantic sites, among the most striking of which is the Dale named the LOVERS' LEAP, on account of a vast precipice which forms one side of a narrow chasm, and from the summit of which a lovelorn female is said to have precipitated herself into the rocky gulf below. Each side of this beautiful dell is bounded by elevated rocks, the proximity of which is such, that for a considerable space there is scarcely room for the passage of the bubbling current of the Wye. Several of these rocks are perpendicular, and bare of vegetation; while others are covered with ivy, yew, and ash-wood, with a craggy steep occasionally starting through the verdure.—A circular road, extending in circumference about three miles, passes in view of the most romantic part of this dale, and forms a very agreeable walk or ride from Buxton. At the southern extremity the scenery assumes a milder character, the hollow taking the name of MILL DALE, from a mill which is turned by the stream. In conjunction with a rude bridge, a mountainous path, and other rural objects, this forms a very picturesque view. Another fine scene is presented by a lofty rock, called SWALLOW TOR, which soars over a mass of wood, the river at its base foaming and roaring over broken masses of limestone.

THE MOORS.

Derbyshire is every where fruitful in natural curiosities, among the most striking of which may be reckoned the Moors of Hope Parish, inasmuch as they afford an extraordinary instance of the preservation of human bodies interred in them. In the year 1674 a grasier and his female servant in crossing these moors on their way to Ireland, were lost in the snow, with which they were covered from January to May, when on their being found, the bodies were so offensive that the Coroner ordered them to be buried on the spot. After a lapse of twenty-nine years, on the ground being opened, they were in no way changed, the colour of the skin being fair and natural, and the flesh as soft as that of persons newly dead. For twenty succeeding years they were occasionally exposed as a spectacle, but carefully covered after being viewed. They lay at the depth of about three feet, in a moist soil or moss. The Minister of Hope Parish was present in 1716, forty-two years after the accident, at a particular inspection of these bodies. On the stockings being drawn off, the man's legs, which had not been uncovered before, were quite fair: the flesh, when pressed by the finger, pitted a little; and the joints played freely, without the least stiffness. Such parts of the clothing as the avidity of the country people, to possess so great a curiosity, had spared, were firm and good; and a piece of new serge, worn by the woman, did not appear to have undergone any sensible change.

OTHER ENGLISH CURIOSITIES.

Having thus brought to a conclusion our details relative to the wonders of the Peak, and the various and interesting natural curiosities there to be found, we subjoin a brief notice of several others, which have, in our island, attracted the notice of travellers.

Among the extraordinary caverns to be found in the mountains of the north of England, may be reckoned Yordas Cave, in the vale of Kingsland, in Yorkshire, which contains a subterraneous cascade. Whethercot Cave, not far from Ingleton, is divided by an arch of limestones, pass-

ing under which is seen a large cascade falling from a height of more than sixty feet. The length of this Cave is about one hundred and eighty-feet, and the breadth ninety.

There are also in various parts of England many remarkable springs, of which some are impregnated either with salt, as that of Droitwich, in Worcestershire; or sulphur as the famous well of Wigan, in Lancashire, or bituminous matter, as that at Pitchford, in Shropshire. Others have a petrifying quality; as that near Lutterworth, in Leicestershire, and a dropping well in the West Riding of Yorkshire. And, finally, some ebb and flow, as that of the Peak described above, and Laywell near Torbay, whose waters rise and fall several times in an hour. To these we may add that remarkable fountain near Richard's Castle, in Herefordshire, commonly called Bone Well, which is generally full of small bones, like those of frogs or fishes, though often cleared out. At a cliff near Wigan, in Lancashire, is the famous burning well; the water is cold, neither has it any smell; yet so strong a vapour of sulphur issues out with the stream, that upon applying a light to it, the top of the water is covered with a flame, like that of burning spirits, which lasts several hours, and emits such a heat that meat may be boiled over it.

BRITISH MOUNTAINS.

" The British Isles present many mountains of a bold and imposing character: when contrasted, however, with those which have been already described, they must be considered as comparatively diminutive.

BEN NEVIS.

The loftiest of these mountains is Ben Nevis, in Scotland, its elevation above the level of the sea being 4380 feet, somewhat more than four-fifths of a mile. It terminates in a point, and elevates its rugged front far above all the neighbouring mountains. It is of easy ascent; and at the perpendicular height of 1500 feet, the vale beneath presents a very

agreeable prospect, the vista being beautified by a diversity of bushes, shrubs, and birch woods, besides many little verdant spots. The sea and the shore are also seen.

At the summit, the view extends at once across the Island, eastwards towards the German sea, and westward to the Atlantic Ocean. Nature here appears on a majestic scale and the vastness of the prospect engages the whole attention, at the same time the objects in view are of no common dimensions: Just over the opening of the sound, at the south west-corner of Mull, Colonsay rises out of the sea like a shade of mist, at the distance of more than ninety miles. Shuna and Lismore appear like small spots of rich verdure, and, though nearly thirty miles distant, seem quite under the spectator. The low parts of Jura cannot be discerned, nor any part of Isla; far less the coast of Ireland, as has been asserted. Such is, however, the wide extent of view, that it extends 170 miles from the horizon of the sea at the Murray Frith, on the N. E. to the Island of Colonsay, on the S. W.

On the N. E. side of Ben Nevis is an almost perpendicular precipice, certainly not less than 1400 feet in depth: probably more, as it appears to exceed the third part of the entire height of the mountain. A stranger is astonished at the sight of this dreadful rock, which has a quantity of snow lodged in its bosom throughout the whole year. The sound of a stone thrown over the cliff to the bottom, cannot be heard when it falls, so that it is impossible to ascertain in that way the height of the precipice.

SNOWDON.

[*See Plate, No. 20.*]

This is the loftiest of the Welch mountains, its elevation above the level of the sea being 3720 feet, nearly three quarters of a mile. It is accessible on one side only, its flanks being in every other quarter precipitous. Its aspect soon convinces the spectator he is not to look to the Alps alone, or to the rocky regions of Altai, bordering on Siberia, for romantic scenes of wilderness, confusion, and disorder. Snowdon presents them in all their rude and native majesty.

In the ascent, a narrow path not more than nine feet in width, leads along the margin of a frightful precipice of

nearly 1500 feet in extent, so perpendicular that it cannot be approached without terror; while to the north of the summit nearest to the one the most elevated, a semi-amphitheatre of precipitous rocks, also of a great height, is seen; and, behind this summit, another semicircle of equal depth and extent. The loftiest summit here appears to descend in the form of a sharp ridge, and beneath it another appears, which, on account of its colour, is called the Black Rock. From the upper part of the valley one of these summits presents a grand, vertical, and very elevated point.

The bottom of each of the amphitheatres of rocks, thirteen in number, is occupied by a small lake of a circular form, and very deep. The one known by the name of Llyn Glass is remarkable for its green hue, derived from its being impregnated with copper, several mines of which line its borders. Than this mountain nothing in the Alps can be more arid and desert, those regions alone excepted which are too lofty to admit of vegetation. Here there is not a tree; not even a shrub: small patches of verdure, which sheep can scarcely reach, are alone to be seen. Its summit, or highest peak, is a flat of about eighteen feet only in circumference. Thence may be seen a part of Ireland, a part of Scotland, Cumberland, Lancashire, Cheshire, all North Wales, the Isle of Man, and the Irish and British seas, with innumerable lakes; while the whole Island of Anglesea is displayed so distinctly, that its flat uncultivated plains, bounded by the rich Parys mountain in the vicinity of Holyhead, may be descried as on a map.

CADER IDRIS.

To the south of Dolgellau, Cader Idris towers above the subject mountains, which seem to retire, to allow its base more room to stand, and to afford to their sovereign a better display. It stands on a broad rocky base, with a gradual ascent to its brow, when the peaks elevate themselves in a manner at once abrupt, picturesque, and distinct. The point emphatically named Cader, appears to the eye below to be little superior in height to the saddle; but the third point, or apex, which has a name expressive of its sterility, is neither equal in height, nor in beauty, to the

other two. On its loftiest peak a stone pillar has lately been erected, for the purpose of a trigonometrical survey.

Cader Idris is the commencement of a chain of primitive mountains, and is computed to be 2850 feet above the green of Dolgelly, and 3550 feet, nearly three-fourths of a mile above the level of the sea. A recent traveller has attempted to demonstrate that at some remote period it was a volcano of immense magnitude.

The tract to the south of Cader Idris, as far as Talylyn and Malwydd, is peculiarly grand. High and rugged mountains of every possible form close in on all sides, while huge masses of rock hang over, or lie scattered in mishapen fragments by the side of the road. To add to the effect of this scene, the river Difi forms one continued cataract for five or six miles, overflowing with the innumerable tributary torrents which precipitate themselves from the highest summits of the surrounding rocks; while, to crown the whole, the shady head of Cader Idris towers, the majestic centinel of the group.

PENMAN MAWR.

The country of Caernarvon, in which this mountain is situated, claims precedency over every other in Wales, for the loftiness of its mountains, and the multitude of the eminences which in a curved and indented chain, occupy nearly the whole of its extent.

In proceeding from Conway to Bangor, by a route at once picturesque and romantic, and amid a scenery which varies at every step, Penman-mawr discloses to the traveller its bulky head. It protrudes itself into the sea, and exhibits a fine contrast to the fertility which it interrupts, by a rude view of grey weather-beaten stones and precipices. The passage over the mountain was formerly terrific; but the road has been latterly widened, and secured, near the verge of the precipice, by a small wall about five feet in height. It forms the most sublime terrace in the British Isles, winding round the mountain on the edge of the abrupt cliff; while the vast impending rocks above, the roaring of the waves at a great distance below, and the frequent howling of the wind, all unite to fill the mind with solemnity and awe.

SKIDDAW.

This English mountain, which has an elevation of 3530 feet, nearly three fourths of a mile, above the level of the sea, is situated in Cumberland. It is more remarkable on account of the scenery over which it presides, and which exceeds in beauty whatever the imagination can paint, than for those bold projections and that rugged majesty which might be expected, but which will be here sought in vain. Except at such a distance as smooths the embossed work of all these rich fabrics, and where its double summit makes it a distinguished object to mark and characterize a scene, it may be considered as a tame and inanimate object.

WHARNSIDE.

In the map of Yorkshire, by Jeffries, the height of this mountain is greatly exaggerated, its elevation above the sea not being more than 2500 feet, nearly half a mile. As it is situated in the midst of a vast amphitheatre of hills, the prospect it affords is diversified with pleasing objects. On its summit are four or five small lakes, two of which are about nine hundred feet in length, and nearly the same in breadth. A thin seam of coal also occurs near the top, and another is said to correspond with it on the summit of the lofty Colm-hill, on the opposite side of Dent-dale. Numerous caves and other natural curiosities abound here, as well as on Pennigent, about six miles to the eastward of Ingleborough. These latter mountains do not possess any particular interest.

STROMBOLI.

[*See Plate, No.* 19.]

This is the principal of the cluster of small Islands, lying to the north of Sicily, named the Lipari Isles, the whole of which contain volcanoes. At a distance its form appears to be that of an exact cone, but on a closer examination it is found to be a mountain having two summits of different heights, the sides of which have been torn and

shattered by craters. The most elevated summit, inclining to the S. W. is agreeably to Spallanzani, about a mile in height.

In this volcanic mountain the effects of a constantly active fire are every where visible, heaping up, destroying, changing, and overturning every instant what itself has produced, and incessantly varying in its operations. At the distance of one hundred miles the flames it emits are visible, whence it has been aptly denominated the light-house of that part of the Mediterranean Sea.

From the more elevated summit, all the inner part of the burning crater, and the mode of its eruption, may be seen. It is placed about half way up, on the N. W. side of the mountain, and has a diameter not exceeding 250 feet. Burning stones are thrown up at regular intervals of seven or eight minutes, ascending in somewhat diverging rays. While a portion of them roll down towards the sea, the greater part fall back into the crater; and these being again cast out by a subsequent eruption, are thus tossed about until they are broken and reduced to ashes. The volcano, however, constantly supplies others, and seems inexhaustible in this species of productions. Spallanzani affirms that, in the more violent eruptions, the ejected matter rises to the height of half a mile, or even higher, many of the ignited stones being thrown above the highest summit of the mountain.

The erupted stones, which appear black in the day-time, have at night a deep red colour, and sparkle like fire-works. Each explosion is accompanied by flames or smoke, the latter resembling clouds, in the lower part black, in the upper white and shining, and separating into globular and irregular forms. In particularly high winds from the S. or S. E. the smoke spreads over every part of the island. Spallanzani observed this volcano on a particular night, when the latter of these winds blew with great violence. The clear sky exhibited the appearanse of a beautiful aurora borealis over that part of the mountain on which the volcano is situated, and which from time to time became more red and brilliant, in proportion as the ignited stones were thrown to a greater height. The violence of the convulsions depends on that of the wind.

The present crater has burned for more than a century,

without any apparent change having taken place in its situation. The side from which the showers of ignited matter fall into the sea, is almost perpendicular, about half a mile broad at the bottom, and a mile in length, terminating above in a point. In rolling down, the lava raises the fine sand like a cloud of dust. While this was observed by Spallanzani, the volcano suddenly made an eruption. Numerous pieces of lava, of a dark red colour, and enveloped in smoke, were ejected from the top of the precipice, and thrown high into the air. A part of them fell on the declivity, and rolled down, the smaller preceded by the greater; and, after a few bounds, dashed into the sea, giving out a sharp hissing sound. The more minute fragments, from their lightness and the hindrance of the sand, rolled slowly down and striking against each other, produced nearly the same sound as hail stones falling on a roof. In a few minutes another explosion followed, without any sensible noise; and two minutes after, a third eruption took place, with a much louder explosion than the first, and a far more copious ejection of lava. The eruptions, which were almost innumerable during the time Spallanzani remained there, all exhibited the same appearances.

On the night following the one above described, the volcano raged with still greater violence, and rapidly hurled to a great height thousands of red-hot stones, forming diverging rays in the air. Those which rolled down the precipice produced a hail of streaming fire, which illuminated the steep descent. Independently of these ignited stones, there was in the air which hovered over the volcano, a vivid light which was not extinguished when that was at rest. It was not properly flame, but real light reverberated by the atmosphere, impregnated by extraneous particles, and more especially by the ascending smoke. Besides varying in intensity, it appeared constantly in motion, ascending, descending, dilating, and contracting, but always remaining perpendicular over the mouth of the volcano, which showed that it was occasioned by the conflagration within the crater. The detonations in the greater eruptions resembled the roaring of distant thunder; but, in the more moderate ones, the explosions of a mine. In the smallest they were scarcely audible. Each was some seconds later than the ejection.

Near the mouth of the volcano is a small cavern, a projection above which secures it from the entrance of the ignited stones. From this cavern Spallanzani was enabled to look down into the very bowels of the volcano. He describes the edges of the crater as of a circular form, and not more than 340 feet in circumference, the internal sides contracting as they descend, and assuming the shape of a truncated inverted cone. The crater itself, to a certain height, is filled with a liquid red-hot matter, resembling melted brass. This is the fluid lava, which appears to be agitated by two distinct motions, the one intestine, whirling and tumultuous, and the other that by which it is impelled upward. This liquid matter is raised, sometimes with more, and sometimes with less rapidity, within the crater; and when it has reached within twenty-five or thirty feet of the upper edge, a sound is heard not unlike a short clap of thunder, while at the same moment a portion of the lava, separated into a thousand pieces, is thrown up with indescribable swiftness, accompanied by a copious eruption of smoke, ashes, and sand. A few moments before the report, the superficies of the lava is inflated and covered with large bubbles, some of which are several feet in diameter; on the bursting of these the detonation and fiery shower take place. After the explosion, the lava within the crater sinks, but soon rises again as before, and new bubbles appear, which again burst and produce new explosions. When the lava sinks, it gives little or no sound; but when it rises, and particularly when it begins to be inflated with bubbles, it is accompanied by a noise similar, in proportion to the difference of magnitude, to that of liquor boiling vehemently in a cauldron.

LIPARI.

This island, which has given name to the whole cluster, is deserving of notice on account of its celebrated stoves. They are the only vestiges of subterraneous conflagration now remaining, and lie to the west of the city, on the summit of a mountain of considerable elevation, called Monte della Stufe, the Mountain of Stoves. They consist of five excavations, in the form of grottoes; but two of them have been abandoned on account of the great

heat, an exposure to which might cause suffocation. Even the stones are so hot that they cannot be touched; but still the heat varies, and experiences all the vicissitudes of volcanoes. The ground is not penetrated with hot vapours issuing from several apertures, as has been asserted: Spallanzani, however, found one from which a thin stream of smoke issued from time to time, with a strong sulphureous smell indicating the remains of conflagration existing beneath.

It is impossible to fix the exact epoch at which the fires of Lipari were extinguished, or rather the period at which the eruption ceased, for the existence of the former may be deduced from the hot springs and stoves. Dolomieu thinks the last eruptions are as old as the sixth century of the Christian era, and conjectures that they may have ceased since the fires found a new vent in Vulcano, since he does not entertain any doubt but that the two islands have a subterraneous communication. Of this the inhabitants of Lipari are so well convinced, that they are in the greatest agitation when Vulcano does not smoke, and when its passages are obstructed. They fear shocks and violent eruptions, suspecting even that the fires may again break out in their own island. It is certainly a fact that the earthquakes, which are very frequent, generally cease when the eruptions of Vulcano commence.

VULCANO.

This, which is the last of the Lipari isles, bears in every part the stamp of fire. It was the superstitious belief of the ancient inhabitants that Vulcan had here established his forges, there being constant fires during the night, and a thick smoke throughout the day. It consists of a mountain in the form of a truncated cone, which is, however, merely a case opening and exposing to view a second cone within, more exact than the other, and in which the mouth of the volcano is placed. The latter is thus enveloped on three sides by the ancient cone,. and is open only on that side which is immediately washed by the sea.

The base of the interior cone is separated from the steep sides of the ancient crater by a circular valley, which terminates on one side at the junction of the two mountains,

and on the other sinks into the sea. In this valley light pumice-stones are blended with fragments of black vitreous lava, and buried in ashes perfectly white. The blow of a hammer on these stones produces a loud hollow sound, which re-echoes in the neighbouring caverns, and proves that the surface is nothing more than the arch of a vault covering an immense abyss. The sound varies according to the thickness of the crust, which must have considerable solidity to support the weight of the new mountain. This, according to Dolomieu, is higher and steeper than the cone which contains the crater of Etna, and its access still more difficult; its perpendicular height, however, is not more than 2640 feet, half a mile. He represents the crater of Vulcano as the most magnificent he ever saw; and Spallanzani observes that, with the exception of that of Etna, he does not know of any more capacious and majestic. It exceeds a mile in circuit, has an oval mouth, and its greatest diameter is from the S. E. to the W., while its depth is not more than a quarter of a mile. The bottom is flat, and from many places streams of smoke exhale, emitting a strong sulphureous vapour. This vast cavity is very regular, and as its entire contents are displayed to the eye presents one of the grandest and most imposing spectacles in nature. On large stones being rolled down, the mountain re-echoes; and on their reaching the bottom, they appear to sink in fluid. Indeed with the aid of a glass, two small lakes, supposed to be filled with melted sulphur, have been discovered. The declivity of the interior walls is so great, that, even when there is not any danger from fire, the descent is next to impossible. After considerable difficulty, however, this was accomplished by Spallanzani on the S. E. side, the only one accessible. He found the bottom to be somewhat more than one third of a mile in circumference, and of an oval form. The subterraneous noise was here much louder than on the summit, sounding like an impetuous river foaming beneath, or, rather, like a conflict of agitated waves meeting and clashing furiously together.—The ground was likewise in some places perforated with apertures, from which hissing sounds issued, resembling those produced by the bellows of a furnace. It shook when pressed by the feet; and a large piece of lava, let fall five or six feet, produced a subterraneous echoing

sound, which continued some time, and was loudest in the centre. These circumstances, combined with its burning heat, and the strong stench of sulphur it emits, prove that the fires of the volcano are still active.

Its eruptions have been most considerable during the earthquakes which have desolated Sicily and a greater part of Italy. In the month of March, 1786, after subterraneous thunders and roarings, which were heard over all the Islands, to the great terror of the inhabitants, and were accompanied by frequent concussions, the crater threw out a prodigous quantity of sand, mixed with immense volumes of smoke and fire. This eruption continued fifteen days, and so great was the quantity of sand ejected that the circumjacent places were entirely covered with it to a considerable height. The lava did not flow at the time, at least over the edges of the crater; and indeed, such a current has not happened during the memory of any living person.

THE HIMALAYA MOUNTAINS.

BETWEEN INDIA AND THIBET.

THE great Himalayan snowy range, says Mr. Fraser, is only the high elevated crest of the mountainous tract that divides the plain of Hindostan from those of Thibet, or Lesser Tartary. Far as they predominate over, and precipitously as they rear themselves above the rest, all the hills that appear in distant ranges, when viewed from the plains, are indeed only the roots and branches of this great stem; and, however difficult to trace, the connexion can always be detected between each inferior mountain and some particular member of its great origin.

The horizontal depth of this mountainous tract, on that side which overlooks Hindostan, is no doubt various; but, from the difficulty of the country, a traveller performs a journey of many days before he reaches the foot of the immediate snowy cliffs. The best observations and survey do not authorise the allowance of more than an average depth of about sixty miles from the plains to the commencement of these, in that part of the country that forms the subject of this narrative. The breadth of the snowy zone itself in all probability varies still more; for

huge masses advance in some places into the lower districts, and in others the crest recedes in long ravines, that are the beds of torrents, while behind they are clothed by a succession of the loftier cliffs. Every account we receive of a passage through them, (and this is no doubt found most commonly where the belt is narrowest,) gives a detail of many days' journey through the deserts of snow and rocks; and it is to be infered, that on the north-east side they advance to, and retreat from the low ground in an equal irregular manner. Indeed, some accounts would induce the belief, that long ranges, crowned with snow-clad peaks, project in various places from the great spine, and include habitable and milder districts; for, in all the routes of which we have accounts, that proceed, in various directions towards the Trans-Himalayan countries, hills covered with snow are occasionally mentioned as occurring, even after the great deserts are passed, and the grazing country entered. The breadth, then, of this crest of snow-clad rock itself cannot fairly be estimated at less than from seventy to eighty miles.

The great snowy belt, although its loftiest crest is broken into numberless cliffs and ravines, nevertheless presents a barrier perfectly impracticable, except in those places where hollows that become the beds of rivers have in some degree intersected it, and facilitated approach to its more remote recesses; and courageous and attentive perseverance has here and there, discovered a dangerous and difficult path, by which a possibility exists of penetrating across the range. Few rivers hold their course wholly through it: indeed, in the upper part in the Sutlej alone has been traced beyond this rocky barrier; and there is a path along its stream, from different parts of which roads diverge, that lead in various directions through the mountain. No reasonable doubt can now exist of the very long and extraordinary course which this river takes.

Captain Webb of the Bengal establishment, was lately employed on a survey of a province of Kumaoon. On the 21st day of June, his camp was 11,680 feet above Calcutta. The surface was covered with very rich vegetation as high as the knee: very extensive beds of strawberries in full flower; and plenty of currant-bushes in blossom all around, in a clear spot of rich black mould

soil, surrounded by a noble forest of pine, oak, and rhododendra. On the 22nd of June he reached the top of Pilgoenta-Churhaee, (or ascent,) 12,642 feet above Calcutta. He was prevented from distinguishing very distant objects by a dense fog around him; but there was not the smallest patch of snow near him, and the surface a fat black mould through which the rock peeped, was covered with strawberry plants (not yet in flower,) butter-cups, dandelion, and a profusion of other flowers. The shoulders of the hill above him, about 450 feet more elevated, were covered with the same to the top; and above 500 feet below was a forest of pine, rhododendron, and birch. There was some snow seen below in deep hollows, but it dissolves in the course of the season.

These facts led Captain Webb to infer, that the inferior limit of perpetual congelation on the Himala mountains is *beyond* 13,500 feet, at least, above the level of Calcutta: and that the level of the table land of Tartary, immediately bordering on the Himala, is very far elevated beyond 8000 feet, the height at which it has been estimated: and altho' I may not be able either to make all the deductions which they will afford, or to shun any errors that they may involve, they will still, I think, yield some ground of inference to estimate the height to which I ascended; and consequently, give some approximation to the heights of the surrounding peaks.

On the night of the 16th of July, we slept at Bheemkeudar, near the source of the Coonoo and Bheem streams.—There is no wood near this place, even in the very bottom of the valley, and we had left even the stunted birch at a considerable distance below: but there was a profusion of flowers, ferns, thistles, &c. and luxuriant pasturage.—Captain Webb's limit of wood is at least as high as 12,000 to 12,300 feet. I would, therefore, presume the site of Bheemkeudar to be considerably above that level; say 13,000 to 13,300 feet above the level of Calcutta. From thence we ascended at first rather gradually, and then very rapidly, till we left all luxuriant vegetation, and entered the region of stripped and scattered and partially melting snow, (for nearly two miles of the perambulator.) From calculating the distance passed, and adverting to the elevation we had attained. I would presume

that this was at least 1500 feet above Bheemkendar, or from 14,500 to 15,000 feet above Calcutta.

We proceeded onwards, ascending very rapidly, while vegetation decreased gradually to a mere green moss, with here and there a few snow-flowers starting through it; snow fast increasing, till at length we entered on what I presume was the perennial and unmelting snow, entirely beyond the line of vegetation, where the rock was bare even of lincheas: and in this we ascended, as I think, about 800 feet; for, though Bamsooroo Ghat may not be so far above this line, we continued ascending, even after crossing that point, and I would incline to estimate this utmost extent of ascent at 2000 feet more, or nearly 17,000 feet above the level of Calcutta.

Whilst proposing to consider the point of 16,000 to 16,500 feet as that of inferior congelation, I must observe that there was no feeling of *frost* in the air, and the snow was moist, though hard, chiefly through the influence of a thick mist, which, in fact, amounted to a very small drizzling rain, which fell around: all which would seem to indicate, that the true line of congelation had not there been attained; but we were surrounded by snow which evidently never melted. To a great depth below it extended all over the hills, very litt[illegible]roken, while on the valleys from whence the Coonoo [illegible]heem streams issue, at full 2000 feet below it lay covering them and the surrounding mountains in an unbroken mass, many hundred feet thick. Thus, though it may seem contradictory, the line of perpetual congelation, in fact seems fixable at even below the point I have ventured to indicate; and, I presume might, on these grounds, be placed somewhere between 15 and 16,000 feet above the level of Calcutta.

The result of all the considerations that arise out of the foregoing remarks is a belief, that the loftiest peaks of the Himala range will be found to fall considerably short of the height attributed to them by Mr. Colebrooke; and that their loftiest peaks do not more than range from 18,000 to 22 or 23,000 feet above the level of the sea.

Having reached the top of an ascent, we looked says Mr. Fraser, down upon a very deep and dark glen, called Palia Gadh, which is the outlet to the waters of one of the most terrific and gloomy valleys I have ever seen.

But it would not be easy to convey by any description a just idea of the peculiarly rugged and gloomy wildness of this glen: it looks like the ruins of nature, and appears, as is said to be, completely impracticable and impenetrable. Little is to be seen except dark rock: wood only fringes the lower parts and the waters' edge: perhaps the spots and streaks of snow, contrasting with the general blackness of the scene, heighten the appearance of desolation. No living thing is seen; no motion but that of the waters; no sound but their roar. Such a spot is suited to engender superstition, and here it is accordingly found in full growth. Many wild traditions are preserved, and many extravagant stories related of it.

The glen above described is by far the most gloomy savage scene we have yet met with. I regret that the weather did not permit a sketch of it to be attempted. Beyond this we could see nothing in the course of the river but rocky banks. The opposite side is particularly precipitous; yet along its face a road is carried, which is frequented as much as this, and leads to villages still farther up. By the time we had reached the village, the clouds which had lowered around and sunk down on the hills, began to burst with loud thunder and heavy rain. The noise was fearfully reverberated among the hills; and during the night more than once the sound was heard of fragments from the brows of the mountains, crashing down to the depths below with a terrific din. Our quarters were good. I slept in a temple, neat, clean and secure from the weather.

GUNGOTREE, THE SOURCE OF THE JUMNA, A BRANCH OF THE GANGES, IN THE HIMALA MOUNTAINS.

Gungotree, the source of the Jumna, the most sacred branch of the Ganges, ought to hold and does bear the first rank among its holy places. Here, says Mr. Fraser, all is mythological if not holy ground. Here Mahadeo sits enthroned in clouds and mist amid rocks that defy the approach of living thing, and snows that make desolation more awful. Gods, goddesses, and saints here continually adore him at mysterious distance, and you traverse their familiar haunts. But, although Gungotree be the most sacred, it is not the most frequented shrine,

access to it being far more difficult than to Baddrinauth; and consequently to this latter, pilgrims flock in crowds, appalled at the remoteness and danger of the former place of worship. This may pretty fully account for the superior riches and splendour of Baddrinauth. Here are temples of considerable extent, priests and officials in abundance, who preserve an imposing exterior, and an appearance venerable from power and comparative magnificence, and consequently procure rich and ample offerings to keep up their comfortable dignity.

The temple of Bhadri-Nath, is situated on the west bank of the Alackunda, in a valley four miles long, and one mile in its greatest breadth. The east bank rises considerably higher than the west bank, and is on a level with the top of the temple. The position of the sanctuary is considered equi-distant from two lofty mountains, which are designated by the names of the Nar and the Narayena Purvatas. The former is to the east, the latter to the west, and completely covered with snow from the summit to the base.

The temple of Bhadri-Nath has more beneficed lands attached to it than any sacred Hindu establishment in this part of India. It is said to possess 700 villages in different parts of Gurwhal and Kumaoon: many of them have been conferred by the government; others have been given in pledge for loans; and some few, purchased by individuals, have been presented as religious offerings.

The annual ceremony of carrying the images of their gods to wash in the sacred stream of the Jumna is (it appears) one of much solemnity among the inhabitants of the neighbourhood; and the concourse of people here assembled has been busily engaged, and continues to be fully occupied in doing honor to it. They dance to the sound of strange music, and intoxicate themselves with a sort of vile spirit, brewed here from grain and particular roots, sometimes, it is said sharpened by pepper. The dance is most grotesque and savage: a multitude of men taking hands sometimes in a circle, sometimes in a line, beating time with their feet, bend with one accord, first nearly to the earth with their faces, then backwards, and then sidewise, with various wild contortions. These, and their uncouth dress of black and grey blankets, give

a peculiar air of brutal ferocity to the assemblage. The men dance all day, and in the evening they are joined by the women who mix indiscriminately with them, and keep up dancing and intoxication till the night is far advanced. They continue this frantic kind of worship for several days; and, in truth, it is much in unison with their general manners and habits,—savage and inconsistent.—At a place so sacred, the residence of so many Brahmins, and the resort of so many pious pilgrims, we might expect to find a strict attention to the forms of religion, and a scrupulous observance of the privations and austerities enjoined by it. So far, however, is this from the truth, that much is met with, shocking even to those Hindoos who are less bigotted.

There were several points to be arranged before we could set off for Gungotree, the source of the Jumna. I did not deem it proper to go unarmed; but agreed that only five men should be accoutred to attend us, and that I should myself carry my gun. But all these weapons of war were to be put aside before we got within sight of the holy spot, and deposited in a cave near it, under a guard. I also pledged myself that no use should be made of these instruments, nor any life sacrificed for the purpose of food, either by myself or by any of my people, after leaving the village, until we returned: moreover, that I would not even carry meat of any sort, dead or alive, along with me, but eat only rice and bread. As to the putting off my shoes, they did not even propose it to me, and it could not have been done; but I volunteered to put them off, when entering into the precincts of the temple and holier places, which pleased them greatly. All the Hindoos, including the Ghoorkhas, went from the village barefoot.

Just at the end of the bridge there is an overhanging rock, under which worship is performed to Bhyram, and a black stone partly painted red, is the image of the god; and here prayers and worship alone were not performed, but every one was obliged to bathe and eat bread baked by the Brahmins, as preparatory to the great and effectual ablutions at the holier Gungotree. This occupied a considerable time, as the party was numerous: in the meantime I took a very imperfect sketch of the scene, after

which I bathed myself at the proper place (which is the junction of the two streams,) while the Brahmin prayed over me. Among the ceremonies performed, he made me hold a tuft of grass while he prayed, which at the conclusion he directed me to throw into the eddy occasioned by the meeting of the two waters.

By an unpleasant path we reached a step, or level spot on the first stage of the mountain, where, in a thick grove of fir trees, is placed a small temple to Bhyram, a plain white building, built by order of Umur Sing T'happa, who gave a sum of money to repair the road, and erect places of worship here, and at Gungotree.—Having paid our respects to Byramjee, we proceeded along the side of the hill on the right bank (north) of the river, gradually ascending by a path equally difficult and dangerous as the first part of our ascent, but more fearful, as the precipice to the river, which rolls below us, increases in height, and exceedingly toilsome from the nature of the ground over which it passes, and which consists wholly of sharp fragments from the cliffs above, with fallen trunks and broken branches of trees.

The path increases in difficulty from the very irregular nature of the ground, as well as the steepness of the hill face across which it leads, ascending and descending as the small, though deep, watercourses furrow the mountain side, in loose soil, formed of small fragments fallen from above, and which slip down, threatening to carry the traveller to the gulph below. The shapeless blocks of rock now more completely obstructed the way, and for hundreds of yards, at times, the passenger must clamber over these masses, heaped as they are one upon another, in monstrous confusion, and so uncertain and unsteady, that, huge though they are, they shake and move even under the burthen of a man's weight. So painful indeed is this track, that it might be conceived as meant to serve as a penance to the unfortunate pilgrims with bare feet, thus to prepare and render them worthy for the special and conclusive act of piety they have in view, as the object of their journey to these extreme wilds.

The spot which bears the name of Gungotree is concealed by the roughness of the ground, and the masses of fallen rock, so as not to be seen till the traveller comes close upon it.

The temple is situated precisely on the sacred stone on which Bhagirutte used to worship Mahădeo, and is a small building of a square shape for about twelve feet high, and rounding in, in the usual form of pagodas, to the top. It is quite plain, painted white, with red mouldings, and surmounted with the usual melon-shaped ornaments of these buildings. From the eastern face of the square, which is turned nearly to the sacred source, there is a small projection covered with a stone roof, in which is the entrance facing the east, and just opposite this there is a small pagoda-shaped temple to Bhyramjee. The whole is surrounded by a wall of unhewn stone and lime, and the space this contains is paved with flat stones. In this space too there is a comfortable but small house for the residence of the Brahmins who come to officiate. Without the inclosure there are two or three sheds constructed of wood, called *dhurum sallahs*, built for the accommodation of pilgrims who resort here: and there are many caves around formed by overhanging stones, which yield a shelter to those who cannot find accommodation in the sheds.

The scene in which this holy place is situated is worthy of the mysterious sanctity attributed to it, and the reverence with which it is regarded. We have not here the confined gloominess of Bhyram Gattee: the actual dread which cannot but be inspired by the precipices and torrents, and perils of the place, here gives way to a sensation of awe, imposing but not embarrassing, that might be compared to the dark and dangerous pass to the centre of the ruins of a former world; for, most truly, there is little here that recalls the recollection of that which we seem to have quitted. The bare and peaked cliffs which shoot to the skies, yield not in ruggedness or elevation to any we have seen; their ruins lie in wild chaotic masses at their feet, and scantier wood imperfectly relieves their nakedness: even the dark pine more rarely roots itself in the deep chasms which time has worn. Thus on all sides is the prospect closed, except in front to the eastward; where, from behind a mass of bare spires, four huge, lofty, snowy peaks arise; these are the peaks of Roodroo-Himala.—There could be no finer finishing, no grandeur close to such a scene, as is visible in the engraving.

We approach it through a labyrinth of enormous shapeless masses, of granite, which during ages have fallen from the cliffs above that frown over the very temple, and in all probability will some day themselves descend in ruins and crush it. Around the inclosure, and among these masses, for some distance up the mountain, a few fine old pine trees throw a dark shade, and form a magnificent fore-ground; while the river runs impetuously in its shingly bed, and the stifled but fearful sound of the stones which it rolls along with it, crushing together, mixes with the roar of its waters.

It is easy to write of rocks and wilds, of torrents and precipices; it is easy to tell of the awe such scenes inspire: this style and these descriptions are common and hackneyed. But it is not so simple, to many surely not very possible, to convey an adequate idea of the stern and rugged majesty of some scenes; to paint their lonely desertness, or describe the undefinable sensation of reverence and dread that steals over the mind while contemplating the death-like ghastly calm that is shed over them: and when at such a moment we remember our homes, our friends, our firesides, and all social intercourse with our fellows, and feel our present solitude, and far distance from all these dear ties, how vain it is to strive at description! Surely such a scene is Gungotree. *(See Plate, No. 21.)* Nor is it independent of the nature of the surrounding scenery, a spot which lightly calls forth powerful feelings. We were now in the centre of the stupendous Himala, the loftiest and perhaps most rugged range of mountains in the world. We were at the acknowledged source of that noble river, equally an object of veneration and a source of fertility, plenty, and opulence to Hindostan; and we had now reached the holiest shrine of Hindoo worship which these holy hills contain. These are surely striking considerations, combining with the solemn granceur of the place, to move the feelings strongly.

The fortuitous circumstance of being the first European that ever penetrated to this spot was no matter of boast, for no great danger had been braved, no extraordinary fatigues undergone: the road is now open to any other who chooses to attempt it, but it was a matter of satisfaction to myself. The first object of inquiry that naturally

occurs to the traveller, after casting a glance over the general landscape, is the source of the river. Here, as at Jumnotree, you are told that no mortal has gone, or can go further towards its extreme origin than this spot; and the difficulty is indeed very apparent. I made a trial to gain a point about two furlongs beyond the temple, both for the purpose of observing the course of the river, and of seeing Gungotree in another point of view. But having with considerable difficulty made my way over the unsteady fragments for some hundred yards, at the risk of being precipitated into the stream, I was forced to turn back.

The source is not more than five miles horizontal distance from the temple, and in a direction south-east, 85° nearly; and beyond this place it is in all probability chiefly supplied by the melting of the great bosom of snow which terminates the valley, and which lies between the peaks of the great mountain above mentioned.

This mountain, which is considered to be the loftiest and greatest of the snowy range in this quarter, and probably yields to none in the whole Himalaya, obtains the name of Roodroo Himala, and is held to be the throne or residence of Mahadeo himself. It is also indiscriminately called Pauch Purbut, from its five peaks; and Soomeroo Purbot, which is not to be confounded with the mountain so called near Bunderbouch; and sometimes the general appellation of Kylas is given, which literally signifies any snowy hill, but is applied to this mountain by way of pre-eminence. It has five principal peaks, called Roodroo Himala, Burrumpooree, Bissenpooree, Oodgurre Kanta, and Soorga Rounee. These form a sort of semi-circular hollow of very considerable extent, filled with eternal snow, from the gradual dissolution of the lower parts of which the principal part of the stream is generated: probably there may be smaller hollows beyond the point to the right above Gungotree, which also supply a portion.

Within the temple there are three images: one, that of Kali: and the elevated stone shelf on which they were placed was wet and soiled with the offerings made: there was a peculiar smell, but I know not whence it proceeded. The place, as usual, was lighted by a small lamp: no

day-light had admittance. Just below the temple, on the river side, grew three poplar-trees, and a few small larches: above there are the remains of a fine old silver firtree, which overshadows some of the caves and sheds. The whole people also bathed, and contributed something to the priesthood; and it was a matter of serious importance, as well as of great joy to every one, that we had thus happily reached a place of such supereminent sanctity: such, indeed, that the act of bathing here is supposed to cleanse from every sin heretofore committed, and the difficulty of which is so great, that few, except professional devotees, ever attempt reaching the holy place.

It is customary that those who have lost their father and mother, or either of these, shall be shaved at this spot; and it was curious to observe the whimsical changes produced by the operation, which numbers underwent. It appears also, that one chief ordinance was the going frequently round the holy temple; and we particularly observed that those who were noted as the greatest rogues were most forward in this pious exercise: one man, in particular, who had been a notorious thief, was unwearied in his perseverance.

Well, indeed, do they say, that Seeva has formed these recesses which he inhabits, inaccessible to all but those whom true devotion leads to his shrine. That man must have been indeed strongly impelled by devotion, ambition, or curiosity, who first explored the way to Gungotree. It were unavailing to enquire, and perhaps of little use, if known, to which of these motives we owe the enterprise; but patience, perseverance, and courage, must have been strongly united with it to lead him safely and successfully through those awful cliffs, that would bar the way to most men. Another omen of favour pointed out was, the increase of the river after bathing, as at Jumnotree; and it is singular enough, that during the time we remained here, I remarked several increases and decreases of the water, without any obvious causes; but these may fairly be referred to the effects of sudden changes of temperature occurring frequently among the hills, and acting on the body of snow that feeds the river.

ASIATIC.



No. 21.—Source of the Jumna, near Gungotree.



ASIATIC MOUNTAINS.

Among the Asiatic burning mountains, a brief account of which we introduce after the above interesting notice of the grand Himalaya chain, those of Japan are both remarkable and numerous. On the summit of a mountain in the province of Figo, is a large cavern, formerly the mouth of a volcano, but the flame of which has ceased, probably for want of combustible matter. In the same province, near a religious structure called the Temple of the Jealous God of Aso, a perpetual flame issues from the top of a mountain. In the province of Tsickusen is another burning mountain, where was formely a coal-pit, which having been set on fire by the carelessness of the workmen, has been burning ever since. Sometimes a black smoke, accompanied by a very disagreeable stench, is observed to issue from the summit of a famous mountain called Fesi, in the province of Seruga. This mountain is said to be nearly as high as the Peak of Teneriffe, but in shape and beauty is supposed not to have an equal. Its top is covered with perpetual snow. Belonging to the Japanese cluster, and not far from Firanda, is a small rocky Island, which has been burning and trembling for many centuries; and in another small Island, opposite to Santzuma, is a volcano which has been burning at different intervals for many ages.

Captain Gore, when leaving Japan, passed by great quantities of pumice-stone, several pieces of which were taken up, and found to weigh from one ounce to three pounds. It was conjectured that these stones had been thrown into the sea by eruptions at various times, as many of them were covered by barnacles (small shells,) and others were quite bare.

VOLCANIC MOUNTAINS OF KAMTSCHATKA.

There are three burning mountains of Kamtschatka, which for many years have thrown out a considerable smoke, but do not often burst into a flame. One of these is situated in the vicinity of Awatska; and another named, the volcano of Tolbatchiek, on a neck of land between the river Kamtschatka, and the Tolbatchiek. In the beginning of the year 1739 the flames issued with such vio-

lence from the crater, as to reduce to ashes the forests on the neighbouring mountains. This was succeeded by a cloud of smoke, which overspread and darkened the whole country, until it was dissipated by a shower of cinders, which covered the ground to the distance of thirty miles. The third volcano is on the top of the particular mountain of Kamtschatka, which is described as by far the highest in the peninsula. It rises, from two rows of hills, somewhat in the form of a sugar-loaf, to a very great height. It usually throws out ashes twice or thrice a year, sometimes in such quantities, that for three hundred versts, one hundred and sixty-five English miles, the earth is covered with them. In the year 1737, at the latter end of September, a conflagration, which lasted for a week, was so violent and terrific, that the mountain appeared, to those who were fishing at sea, like one red-hot rock; and the flames which burst through several openings, with a dreadful noise, resembled rivers of fire. From the inside of the mountains were heard thunderings, crackings, and blasts like those of the strongest bellows, shaking all the neighbouring territory. During the night it was most terrible; but at length the conflagration ended by the mountain's casting forth a prodigious quantity of cinders and ashes, among which were porous stones, and glass of various colours. When Captain Clarke sailed out of the harbour of St. Peter and St. Paul, in June 1778, to the northward, an eruption of the first of these volcanoes was observed. A rumbling noise, resembling distant hollow thunder, was heard before day-light; and when the day broke, the decks and sides of the ships were covered with a fine dust, resembling emery, nearly an inch thick, the air at the same time being charged with this substance to such a degree, that towards the mountain, which is situated to the north of the harbour, the surrounding objects were not to be distinguished. About twelve o'clock, and during the afternoon, the explosions became louder, and were followed by showers of cinders, which were in general about the size of peas, though many were picked up on the deck larger than a hazel-nut. Along with the cinders fell several small stones which had not undergone any change from the action of fire.

VOLCANIC MOUNTAIN OF ALBAY.

The following details of the dreadful eruption of the Volcano of Albay, in the Island of Luconia, one of the Philipines, on the 1st of February, 1814, are from an eye witness of the dreadful scenes it presented.

During thirteen years the Volcano of Albay had preserved a profound silence. It was no longer viewed with that distrust and horror with which volcanoes usually inspire those who inhabit the vicinity. Its extensive and spacious brow had been converted into highly cultivated and beautiful gardens. On the first day of January last, no person reflected, in the slightest degree, upon the damages and losses which so bad a neighbour had once occasioned. Previously to the former eruptions there had been heard certain subterraneous sounds, which were presages of them. But upon the present occasion we remarked nothing, except that on the last day of January we perceived some slight shocks. In the night the shocks increased. At two in the morning one was felt more violent than those hitherto experienced. It was repeated at four, and from that time they were almost continual until the eruption commenced.

The day broke, and I scarcely ever remarked in Camarines a more serene and pleasant morning. I observed, however that the ridges nearest to the volcano were covered with mist, which I supposed to be the smoke of some house that might have been on fire in the night. But at eight o'clock the volcano began suddenly to emit a thick column of stones, sand, and ashes, which with the greatest velocity, was elevated into the highest regions of the atmosphere. At this sight we were filled with the utmost dread, especially when we observed that in an instant the brow of the volcano was quite covered. We had never seen a similar eruption, but were convinced that a river of fire was flowing towards us, and was about to consume us. The first thing which was done in my village was to secure *the holy sacrament from profanation!* we then betook ourselves to flight. The swiftness with which the dreadful tide rolled towards us, did not give us time either for reflection or consultation. The frigthtful noise

of the volcano caused great terror even in the stoutest hearts. We all ran, filled with dismay and consternation, endeavouring to reach the highest and most distant places, to preserve ourselves from so imminent a danger. The horizon began to darken, and our anxieties redoubled. The noise of the volcano continually increased, the darkness augmented, and we continued our flight. But, notwithstanding our swiftness, we were overtaken by a heavy shower of huge stones, by the violence of which many unfortunate persons were in a moment killed. This cruel circumstance obliged us to make a pause in our career, and to shelter ourselves under the houses; but the flames and burnt stones which fell from above, in a short time reduced them to ashes.

The sky was now completely overcast, and we remained enveloped and immersed in a thick and palpable darkness. From that moment reflection was at an end. The mother abandoned her children, the husband his wife, and the chidren forgot their parents.

In the houses we had no longer any shelter. It was necessary to abandon, or perish with them; yet, to go out uncovered, was to expose one's self to a danger not less imminent, because many of the stones were of an enormous size, and they fell as thick as drops of rain. It was necessary to defend ourselves as well as we could. Some covered themselves with hides, others with tables and chairs, and others with boards and tea-trays. Many took refuge in the trunks of trees, others among the canes and hedges, and some hid themselves in a cave, when the brow of a mountain protected them.

About ten o'clock the heavy stones ceased to fall, and a rain of thick sand succeeded. At half past one the noise of the volcano began to diminish, and the horizon to clear a little; and at two it became quite tranquil; and we now began to perceive the dreadful ravages which the darkness had hitherto concealed from us. The ground was covered with dead bodies, part of whom had been killed by the stones, and the others consumed by the fire. Two hundred perished in the church of Budiao, and thirty-five in a single house in that village. The joy the living felt at having preserved themselves, was in many converted into the extremity of sorrow at finding themselves deprived of their relations and friends. Fathers found their children dead,

husbands their wives, and wives their husbands, in the village of Budiao, where there were very few who had not lost some of their nearest connexions. In other places we found many persons extended upon the ground, wounded or bruised in a thousand ways. Some with their legs broken, some without arms, some with their skulls fractured, and others covered with wounds. Many died immediately, others on the following days, and the rest were abandoned to the most melancholy fate, without physicians, without medicines, and in want even of necessary food.

Five populous towns were entirely destroyed by the eruption; more than twelve hundred of the inhabitants perished amidst the ruins; and twenty thousand who survived the awful catastrophe, were stripped of their possessions and reduced to beggary.

The subsequent appearance of the volcanic mountain was most melancholy and terrific. Its side, formerly so well cultivated, and which afforded a prospect the most picturesque, is now become a barren sand. The stones, sand, and ashes, which cover it, in some places exceed the depth of ten and twelve yards; and on the ground where lately stood the village of Budiao, there are spots, in which the cocoa-trees are almost covered. In the ruined villages, and through the whole extent of the eruption, the ground remains buried in the sand to the depth of half a yard, and scarcely a single tree is left alive. The crater of the volcano has lowered more than one hundred and twenty feet; and the south side discovers a spacious and horrid mouth, which is frightful to the view. Three new ones have opened at a considerable distance from the principal crater, through which also smoke and ashes are incessantly emitted. In short, the most beautiful villages of Camrines, and the principal part of that fine province, are deeply covered with barren sand.

ISLANDS WHICH HAVE RISEN FROM THE SEA.

Besides the convulsions of nature displayed in volcanoes, the most remarkable particulars of which we have given in our history of mountains, other operations are carried on below the fathomless depths of the sea, the nature of whic

can only be conjectured by the effects produced. Nor is it more astonishing that inflamable substances should be found beneath the bottom of the sea, than at similar depths on land, and that *there also* the impetuous force of fire should cause the imprisoned air and elastic gasses to expand, and, by its mighty force, should drive the earth at the bottom of the sea above its surface. These Marine volcanoes are perhaps more frequent, though they do not so often come within the reach of human observation, than those on land; and stupenduous must be the operations carried on, when matter is thrown up to an extent which the ingenuity of man does not enable him to reach by fathoming.

Many instances have occured, as well in ancient as in modern times, of Islands having been formed in the midst of the sea; and their sudden appearance has constantly been preceded by violent agitations of the surrounding waters, accompanied by dreadful noises, and in some instances, by fiery eruptions from the newly-formed isles, which are composed of various substances, frequently intermixed with a considerable quantity of volcanic lava.—Such Islands remain for ages barren, but in a long course of time become abundantly fruitful. It is a matter of curious inquiry, whether springs are found on such newly-created spots, when the convulsions which gave them birth have subsided; but on this point it would seem that we are not possessed of any certain information, as it does not appear that they have been visited by any naturalist with the express view of recording their properties.

Among the writers of antiquity who have transmitted accounts of Islands which have thus started up to the view of the astonished spectator, Seneca asserts that, in his time, the Island of Therasea, in the Eagen sea, was seen to rise in this manner, by several mariners who were sailing near the point of its ascent. Pliny's relation is still more extraordinary; for he says that in the Mediterranean, thirteen islands emerged at once from the sea, the cause of which he ascribes rather to the retiring of the waters, than to any subterraneous operation of nature: but he speaks at the same time of the island of Hiera, in the vicinity of Therasea, as having been formed by subterraneous explosions, and enumerates several others said to have been derived from a similar origin, in one of which he says, a great

abundance of fishes were found, of which however all who ate perished soon after.

It is to the Grecian Archipelago and the Azores that we are to look for the grandest and most surprising instances of this phenomenon. We will select an example from each of these groupes of islands, beginning with the former.

Before we enter, however, on the somewhat minute details we shall have to bring forward, on this very curious and interresting subject, it may not be improper to observe, that the Island of Acroteri, of great celebrity in ancient history, appears to have its surface composed of pumice stone, encrusted by a surface of fertile earth; and that it is represented by the ancients as having risen, during a violent earthquake, from the sea. Four neighbouring Islands are described as having a similar origin, notwithstanding the sea is in that part of the Archipelago of such a depth as to be unfathomable by any sounding line. These arose at different times: the first long before the commencement of the Christian era; the second in the first century; the third in the eighth; and the fourth in 1573.

To proceed to a phenomenon of a similar nature, belonging to the same cluster of islands, which being of a more recent date, we are enabled to enter into all its particulars. They are such as cannot fail to interest and surprise.

On the 22d of May, 1707, a severe earthquake was felt at Stanchio, an island of the Archipelago; and on the ensuing morning a party of seamen, discovering not far off what they believed to be a wreck, rapidly rowed towards it; but finding rocks and earth instead of the remains of a ship, hastened back, and spread the news of what they had seen in Santorini, another of these islands. However great the apprehensions of the inhabitants were at the first sight, their surprise soon abated, and in a few days, seeing no appearance of fire or smoke, some of them ventured to land on the new island. Their curiosity led them from rock to rock, where they found a kind of white stone, which yielded to the knife like bread, and nearly resembled that substance in colour and consistence. They also found many oysters sticking to the rocks; but while they were employed in collecting them, the Island moved and shook under their feet, on which they ran with precipitation to

their boats. Amid these motions and tremblings the island increased, not only in height, but in length and breadth: still occasionally, while it was raised and extended on the one side, it sunk and diminished on the other. The person to whom we are indebted for this narrative, observed a rock to rise out of the sea, forty or fifty paces from the island, which, having been thus visible for four days, sunk, and appeared no more: several others appeared and disappeared alternately, till at length they remained fixed and unmoved. In the meantime the colour of the surrounding sea was changed: at first it was of a light green, then reddish, and afterwards of a pale yellow, accompanied by a noisome stench, which spread itself over a part of the Island of Santorini.

On the 16th of July smoke first appeared, not indeed on the island, but issuing from a ridge of black stones which suddenly rose about sixty paces from it, where the depth of the sea was unfathomable. Thus there were two separate islands, one called the White, and the other the Black Island, from the different appearances they exhibited. This thick smoke was of a whitish colour, like that of a lime-kiln, and was carried by the wind to Santorini, where it penetrated the houses of the inhabitants.

In the night between the 19th and 20th of July, flames began to issue with the smoke, to the great terror of the inhabitants of Santorini, especially of those occupying the castle of Scaro, who were distant about a mile and a half only from the burning island, which now increased very fast, large rocks daily springing up, which sometimes added to its length, and sometimes to its breadth. The smoke, also increased, and there not being any wind, ascended so high as to be seen at Candia, and other distant islands. During the night, it resembled a column of five, fifteen, or twenty feet in height; and the sea was then covered with a scurf or froth, in some places reddish, and in others yellowish, from which proceeded such a stench, that the inhabitants throughout the whole island of Santorini burnt perfumes in their houses, and made fires in the streets, to prevent infection. This, indeed, did not last above a day or two; for a strong gale of wind dispersed the froth, but drove the smoke on the vineyards of Santorini, by which the grapes were, in one night, parched up and

destroyed. This smoke also caused violent head-aches, attended with retchings.

On the 31st of July the sea smoked and bubbled in two different places near the island, where the water formed a perfect circle, and looked like oil when beginning to simmer. This continued above a month, during which time many fishes were found dead on the shore of Santorini. On the following night a dull hollow noise was heard, like the distant report of several cannon, which was instantly followed by flames of fire, shooting up to a great height in the air, where they suddenly disappeared. The next day the same hollow sound was several times heard, and succeeded by a blackish smoke, which, notwithstanding a fresh gale blew at the time, rose up to a prodigious height, in the form of a column, and would probably in the night have appeared as if on fire.

On the 7th of August a different noise was heard, resembling that of large stones thrown, at very short intervals, into a deep well. This noise, having lasted for some days, was succeeded by another much louder, so nearly resembling thunder, as scarcely to be distinguished from three or four real claps, which were heard at the same time.

On the 21st the fire and smoke were very considerably diminished; but the next morning they broke out with still greater fury than before. The smoke was red, and very thick, the heat at the same time being so intense, that all around the island the sea smoked and bubbled surprisingly. At night, by the means of a telescope, sixty small openings or funnels, all emitting a very bright flame, were discovered on the highest part of the island, conjointly resembling a large furnace; and, on the other side of the great volcano there appeared to be as many.

On the morning of the 23d, the island was much higher than on the preceding day, and its breadth increased by a chain of rocks which had sprung up in the night nearly fifty feet above the water. The sea was also again covered with reddish froth, which always appeared when the island seemed to have received any considerable additions, and occasioned an intolerable stench, until it was dispersed by the wind and the motion of the waves.

On the 5th of September, the fire opened another vent

at the extremity of the Black Island, from which it issued for several days. During that time little was discharged from the large furnace; but from this new passage the astonished spectator beheld the fire dart up three several times to a vast height, resembling so many prodigious sky-rockets of a glowing lively red. The following night the sub-aqueous fire made a terrible noise, and immediately after a thousand sheaves of fire darted into the air, where breaking and dispersing, they fell like a shower of stars on the island, which appeared in a blaze, presenting to the amazed spectator at once a most dreadful and beautiful illumination. To these natural fire-works, succeeded a kind of meteor, which for some time hung over the castle of Scaro, and which, having a resemblauce to a flaming sword, served to increase the consternation of the inhabitants of Santorini.

On the 9th of September, the White and Black Islands united; after which the western end of the island grew daily in bulk. There were now four openings only which emitted flames; these issued forth with great impetuosity, sometimes attended with a noise like that of a large organ-pipe, and sometimes like the howling of wild beasts.

On the 12th the subterraneous noise was much augmented, having never been so frequent or so dreadful as on that and the following day. The bursts of this subterraneous thunder, like a general discharge of the artillery of an army, were repeated ten or twelve times within twenty-four hours, and, immediately after each clap, the large furnace threw up huge red-hot stones, which fell into the sea at a great distance. These claps were always followed by a thick smoke, which spread clouds of ashes over the sea and the neighbouring islands.

On the 18th of September an earthquake was felt at Santorini. It did but little damage, although it considerably enlarged the burning island, and in several places gave vent to the fire and smoke. The claps were also more terrible than ever; and, in the midst of a thick smoke, which appeared like a mountain, large pieces of rock, which afterwards fell on the island, or into the sea, were thrown up with as much noise and force as balls from the mouth of a cannon. One of the small neighbouring islands was covered with these fiery stones, which being

thinly crusted over with sulphur, gave a bright light, and continued burning until that was consumed.

On the 21st a dreadful clap of subterraneous thunder was followed by very powerful lightnings, and at the same instant the new island was so violently shaken, that part of the great furnace fell down, and huge burning rocks were thrown to the distance of two miles and upwards. This seemed to be the last effort of the volcano, and appeared to have exhausted the combustible matter, as all was quiet for several days after: but on the 25th, the fire broke out again with still greater fury, and among the claps one was so terrible, that the churches of Santorini were soon filled with crowds of people, expecting every moment to be their last; and the castle and town of Scaro suffered such a shock, that the doors and windows of the houses flew open. The volcano continued to rage during the remaining part of the year; and in the month of January, 1708, the large furnace, without one day's intermission, threw out stones and flames, at least once or twice, but generally five or six times a day.

On the 10th of February, in the morning, a pretty strong earthquake was felt at Santorini, which the inhabitants considered as a prelude to greater commotions in the burning island; nor were they deceived, for soon after the fire and smoke issued in prodigious quantities. The thunder-like claps were redoubled, and all was horror and confusion: rocks of an amazing size were raised up to a great height above the water; and the sea raged and boiled to such a degree as to occasion great consternation. The subterraneous bellowings were heard without intermission, and sometimes in less than a quarter of an hour there were six or seven eruptions from the large furnace. The noise of repeated claps, the quantity of huge stones which flew about on every side, the houses at Santorini tottering to their very foundations, and the fire, which now appeared in open day surpassed all that had hitherto happened, and formed a scene terrific and astonishing beyond description.

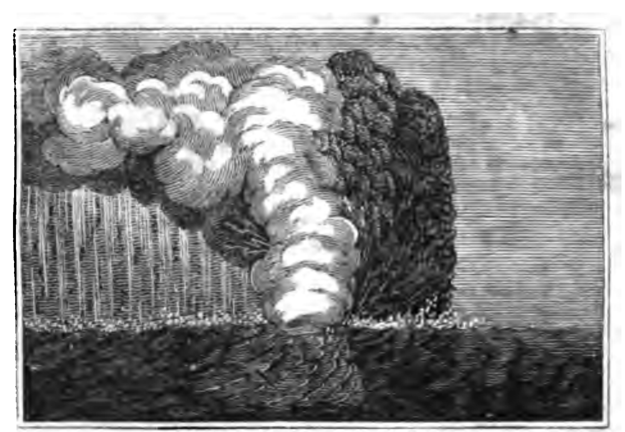
The 15th of April was rendered memorable by the number and violence of the bellowings and eruptions, by one of which nearly a hundred stones were thrown at the same distant into the air, and fell again into the sea at about two miles distant. From that day until the 22nd of

May, which may be considered as the anniversary of the birth of the new Island, things continued much in the same state, but afterwards the fire and smoke subsided by degrees, and the subterraneous thunders became less terrible.

On the 15th of July 1709, the Bishop of Santorini, accompanied by several friars, hired a boat to take a near view of the island. They made directly toward it on that side where the sea did not bubble, but where it smoked very much. Being within the range of this vapour, they felt a close suffucating heat, and found the water very hot; on which they directed their course toward a part of the island at the fartherest distance from the large furnace. The fires, which still continued to burn, and the boiling of the sea, obliged them to make a great circuit, notwithstanding which they felt the air about them to be very hot and sultry. Having encompassed the island, and surveyed it carefully from an adjacent one, they judged it to be two hundred feet above the sea, about a mile broad, and five miles in circumference; but, not being thoroughly satisfied, they resolved to make an attempt at landing, and accordingly rowed toward that part of the island where they perceived neither fire nor smoke. When, however, they had proceeded to within the distance of a hundred yards, the great furnace discharged itself with its usual fury, and the wind blew upon them so dense a smoke, and so heavy a shower of ashes, that they were obliged to abandon their design. Having retired somewhat farther, they let down their sounding lead, with a line ninety-five fathoms in length, but it was too short to reach the bottom. On their return to Santorini, they observed that the heat of the water had melted the greater part of the pitch employed in caulking their boat, which had now become very leaky.

From that time until the 15th of August, the fire, smoke, and noises continued, but not in so great a degree; and it appears that for several years after the island still increased, but that the fire and subterraneous noises were much abated. The most recent account we have been enabled to collect, is that of a late traveller who in 1811, passed this island at some distance. It appeared to him like a stupendous mass of rock, but was not inhabited or cultivated. It had then long ceased to burn.





No. 22.—St. Michael's Volcano.



No. 23.—Sabrina Island.

We have stated that similar eruptions of islands have occurred in the group of the Azores. Thus, in December 1720, a violent earthquake was felt on the island of Tercera. On the following morning a new island, which had sprung up in the night, made its appearance, and ejected a huge column of smoke. The pilot of a ship, who attempted to approach it, sounded on one of these newly-formed islands, with a line of sixty fathoms, but could not find a bottom. On the opposite side, the sea was deeply tinged with various colours, white, blue, and green; and was very shallow. This island was larger on its first appearance, than at some distance of time afterwards; it at length sunk beneath the level of the sea, and is now no longer visible.

"What can be more surprising," observes the author of the preceding account, "than to see fire, not only force its "way out of the bowels of the earth, but likewise make "for itself a passage through the waters of the sea! What "can be more extraordinary, or foreign to our common "notions of things, than to observe the bottom of the sea "rise up in a mountain above its surface, and become so "firm an island as to be able to resist the violence of the "greatest storms! I know that subterraneous fires, when "pent up in a narrow passage, are able to elevate a mass of "earth as large as an island; but that this should be done "in so regular and precise a manner, that the water of the "sea should not be able to penetrate and extinguish those "fires; and that, after they should have exhausted them-"selves, the mass of earth should not fall down, or sink "again with its own weight, but still remain in a manner "suspended over the great arch below—this seems to me "more surprising than any of the facts which have been re-"lated of Mount Etna, Vesuvius, or any other volcano."

In the first part of the Transactions of the Royal Society for the year 1812, Captain Tillard, of the British Navy, has published his very interesting narrative of a similar phenomenon, which occured in the same sea near the Azores. We give this narrative in his own words.

Approaching the island of St. Michael's on Sunday the 12th of June, 1811, in his Majesty's sloop Sabrina, under my command, we occasionally observed, rising in the horizon, two or three columns of smoke, such as would have

been occasioned by an action between two ships, to which cause we universally attributed its origin. This opinion was, however, in a very short time changed, from the smoke increasing and ascending in much larger bodies than could possibly have been produced by such an event; and, having heard an account, prior to our sailing from Lisbon, that in the preceding January or February a volcano had burst out within the sea near St. Michael's, we immediately concluded that the smoke we saw proceeded from that cause, and, on our anchoring the next morning in the road of Ponta del Gada, we found this conjecture correct as to the cause, but not as to the time; the eruption of January having totally subsided, and the present one having only burst forth two days prior to our approach, and about three miles distant from the one before alluded to.

Desirous of examining as minutely as possible a contention so extraordinary between two such powerful elements, I set off from the city of Ponta del Gada on the morning of the 14th, in company with Mr. Read, the Consul General of the Azores, and two other gentlemen. After riding about twenty miles across the N. W. end of the island of St. Michaels, we came to the edge of the cliff, whence the volcano burst suddenly upon our view in the most terrific and awful grandeur. *(See Plate, No. 22.)* It was only a short mile from the base of the cliff, which was nearly perpendicular, and formed the margin of the sea; this cliff being, as nearly as I could judge, from three to four hundred feet high. To give you an adequate idea of the scene by description, is far beyond my powers; but for your satisfaction, I shall attempt it.

Imagine an immense body of smoke rising from the sea, the surface of which was marked by the slippery rippling of the waves, occasioned by the light and steady breezes incidental to these climates in summer. In a quiescent state, it had the appearance of a circular cloud revolving on the water like a horizontal wheel, in various and irregular involutions, expanding itself gradually on the lee side, when suddenly a column of the blackest cinders, ashes, and stones would shoot up in the form of a spire, at an angle of from ten to twenty degrees from a perpendicular line, the angle of inclination being universally to windward; this was rapidly succeeded by a second, third, and fourth shower,

each acquiring greater velocity, and overtopping the other till they had attained an altitude as much above the level of our eye, as the sea was below it.

As the impetus with which the columns were severally propelled diminished, and their ascending motion had nearly ceased, they broke into various branches resembling a group of pines; these again forming themselves into festoons of white feathery smoke, in the most fanciful manner imaginable, intermixed with the finest particles of falling ashes, which at one time assumed the appearance of innumerable plumes of black and white ostrich feathers surmounting each other; and another, that of the light wavy branches of a weeping willow.

During these bursts, the most vivid flashes of lightning continually issued from the densest part of the volcano; and the cloud of smoke, now ascending to an altitude much above the highest point to which the ashes were projected, rolled off in large masses of fleecy clouds, gradually expanding themselves before the wind in a direction nearly horizontal, and drawing up to them a quantity of waterspouts, which formed a most beautiful and striking addition to the general appearance of the scene.

That part of the sea where the volcano was situated, was upwards of thirty fathoms deep, and at the time of our viewing it the volcano was only four days old. Soon after our arrival on the cliff, a peasant observed he could discern a peak above the water: we looked but could not see it; however, in less than half an hour it was plainly visible, and before we quitted the place, which was about three hours from the time of our arrival, a complete crater was formed above the water, not less than twenty feet high on the side where the greatest quantity of ashes fell; the diameter of the crater being apparently about four or five hundred feet.

The great eruptions were generally attended with a noise like the continued firing of cannon and musquetry intermixed, as also with slight shocks of earthquakes; several of which having been felt by my companions, but none by myself, I had become half sceptical, and thought their opinion arose merely from the force of imagination; but while we were sitting within five or six yards of the edge of the cliff, partaking of a slight repast which had been brought with us, and were all busily engaged, one of the

most magnificent bursts took place which we had yet witnessed, accompanied by a very severe shock of an earthquake. The instantaneous and involuntary movement of each was to spring upon his feet; and I said, "This admits of no doubt." The words had scarcely passed my lips, before we observed a large portion of the face of the cliff, about fifty yards on our left, falling, which it did with a violent crash. So soon as our first consternation had a little subsided, we removed about ten or a dozen yards further from the edge of the cliff, and finished our dinner.

On the succeeding day, June 15th, having the Consul and some other friends on board, I weighed, and proceeded with the ship towards the volcano, with the intention of witnessing a night view; but in this expectation we were greatly disappointed, from the wind freshening, and the weather becoming thick and hazy, and also from the volcano itself being clearly more quiescent than it was the preceding day. It seldom emitted any lightning, but occasionally as much flame as may be seen to issue from the top of a glass-house or foundry chimney. On passing directly under the great cloud of smoke, about three or four miles distant from the volcano, the decks of the ship were covered with fine black ashes, which fell intermixed with small rain. We returned the next morning, and late on the evening of the same day I took leave of St. Michael's to complete my cruize.

On opening the volcano clear of the N. W. part of the island, after dark on the 16th, we witnessed one or two eruptions that, had the ship been near enough, would have been awfully grand. It appeared one continued blaze of lightning; but its distance from the ship, upwards of twenty miles, prevented our seeing it with effect. Returning again towards St. Michael's, on the 4th of July, I was obliged, by the state of the wind, to pass with the ship very close to the Island, which was now completely formed by the volcano, being nearly the height of Matlock High Tor, about eighty yards above the sea. At this time it was perfectly tranquil; which circumstance determined me to land, and explore it more narrowly. I left the ship in one of the boats, accompanied by some of the officers. As we approached, we perceived that it was still smoking in many parts, and, upon our reaching the island, found the surf on

the beach very high. Rowing round to the lee side, with some little difficulty, by the aid of an oar, as a pole, I jumped on shore, and was followed by the other officers. We found a narrow beach of black ashes, from which the side of the island rose in general too steep to admit of our ascending; and where we could have clambered up, the mass of matter was much too hot to allow our proceeding more than a few yards in the ascent.

The declivity below the surface of the sea was equally steep, having seven fathoms water at scarcely the boat's length from the shore, and at the distance of twenty or thirty yards we sounded twenty-five fathoms. From walking round it in about twelve minutes, I should judge that it was something less than a mile in circumference; but the most extraordinary part was the crater, the mouth of which, on the side facing St. Michael's, was nearly level with the sea. It was filled with water, at that time boiling, and was emptying itself into the sea by a small stream about six yards over, and by which I should suppose it was continually filled again at high water. This stream, close to the edge of the sea, was so hot, as only to admit the finger to be dipped suddenly in, and taken out again immediately.

It appeared evident, by the formation of this part of the island, that the sea had, during the eruptions, broken into the crater in two places, as the east side of the small stream was bounded by a precipice; a cliff between twenty and thirty feet high, forming a peninsula of about the same dimension in width, and from fifty to sixty feet long, connected with the other part of the island by a narrow ridge of cinders and lava, as an isthmus, of from forty to fifty feet in length, from which the crater rose in the form of an amphitheatre.

This cliff, at two or three miles distance from the island, had the appearance of a work of art resembling a small fort or block-house. The top of this we were determined, if possible, to attain; but the difficulty we had to encounter in doing so was considerable; the only way to attempt it was up the side of the isthmus, which was so steep, that the only mode by which we could effect it, was by fixing the end of an oar at the base, with the assistance of which we forced ourselves up in nearly a backward direction.

Having reached the summit of the isthmus, we found another difficulty; for it was impossible to walk upon it, as the descent on the other side was immediate, and as steep as the one we had ascended; but by throwing our legs across it, as would be done on the ridge of a house, and moving ourselves forward by our hands, we at length reached that part of it where it gradually widened itself, and formed the summit of the cliff, which we found to have a perfectly flat surface, of the dimensions before stated. Judging this to be the most conspicuous situation, we here planted the Union, and left a bottle sealed up, containing a short account of the origin of the island, and of our having landed upon it, and naming it Sabrina Island. *(See Plate, No. 23.)*

Within the crater I found the complete skeleton of a guard-fish, the bones of which, being perfectly burnt, fell to pieces upon attempting to take them up; and, by the account of the inhabitants on the coast of St. Michael's, great numbers of fish had been destroyed during the early part of the eruption, as large quantities, probably suffocated or poisoned, were occasionally found drifted into the small inlets or bays. The island, like other volcanic productions, is composed principally of porous substances, generally burnt to complete cinders, with occasional masses of a stone, which I should suppose to be a mixture of iron and limestone.

Sabrina Island has gradually disappeared, since the month of October, 1811, leaving an extensive shoal. Smoke was discovered still issuing out of the sea in the month of February, 1812, near the spot where this wonderful phenomenon appeared.

SUBTERRANEOUS WONDERS.

THE GREAT KENTUCKY CAVERN.

Give me, ye powers, the wonderous scenes to show,
Conceal'd in darkness, in the depths below.

For a very interesting account of this stupendous cavern, which is unparalleled in the history of subterraneous wonders, we are indebted to Dr. Nahum Ward, who published it in the Monthly Magazine of October 1816. It is situated in Warren County, and in a territory not moun-

tainous, but broken, differing in this respect from all the other caverns hitherto known. The Doctor, provided with guides, two large lamps, a compass, and refreshments, descended a pit forty feet in depth, and one hundred and twenty in circumference; having a spring of fine water at the bottom, and conducting to the entrance of the cavern. The opening, which is to the north, is from forty to fifty feet high, about thirty in width. It narrows shortly after, but again expands to a width of thirty or forty feet, and a height of twenty, continuing these dimensions for about a mile, to the first *hoppers*,* where a manufactory of saltpetre has recently been established. Thence to the second of these hoppers, two miles from the entrance, it is forty-feet in width, and sixty in height. Throughout nearly the whole of the distance handsome walls have been made by the manufacturers, of the loose lime-stones. The road is hard, and as smooth as a flag pavement. In every passage which the Doctor traversed, the sides of the cavern were perpendicular, and the arches, which have bid defiance even to earthquakes, are regular. In 1802, when the heavy shocks of earthquakes came on which were so severely felt in this part of Kentucky, the workmen stationed at the second hoppers, heard about five minutes before each shock, a heavy rumbling noise issue from the cave, like a strong wind. When that ceased, the rocks cracked, and the whole appeared to be going in a moment to final destruction.—However, no one was injured, although large portions of rock fell in different parts of the cavern.

In advancing into the cavern, the avenue leads from the second hoppers, west, one mile; and thence, south-west, to the chief area or city, which is six miles from the entrance. This avenue, throughout its whole extent from the above station to the cross-roads, or chief area, is from sixty to one hundred feet in height, of a similar width, and nearly on a level, the floor or bottom being covered with loose lime-stone, and salt-petre earth. "When," observes the Doctor, "I reached this immense area (called "the chief city) which contains upwards of eight acres, "without a single pillar to support the arch, which is "entire over the whole, I was struck dumb with astonish-

* A hopper is an inverted cone, into which corn is put at a mill before it runs between the stones.

"ment.—Nothing can be more sublime and grand than "this place, of which but a faint idea can be conveyed, "covered with one solid arch at least one hundred feet "high, and to all appearance entire."

Having entered the area, the Doctor perceived five large avenues leading from it, from sixty to one hundred feet in width, and about forty in height. The stone walls are arched, and were from forty to eighty feet perpendicular in height before the commencement of the arch.

In exploring these avenues, the precaution was taken to cut arrows, pointing to the mouth of the cave, on the stones beneath the feet, to prevent any difficulty in the return. The first which was traversed, took a southerly direction for more than two miles; when a second was taken, which led first east, and then north, for more than two miles further. These windings at length brought the party, by another avenue, to the chief city again, after having traversed different avenues for more than five miles. Having reposed for a few moments on slabs of limestone near the centre of this gloomy area, and refreshed themselves and trimmed their lamps, they departed a second time, through an avenue almost north, parallel with the one leading from the chief city to the mouth of the cavern; and, having proceeded upwards of two miles, came to the second city. This is covered with a single arch, nearly two hundred feet high in the centre, and is very similar to the chief city, except in the number of its avenues which are two only. They crossed it over a very considerable rise in the centre, and descended through an avenue which bore to the east, to the distance of nearly a mile, when they came to a third area, or city, about one hundred feet square, and fifty in height, which had a pure and delightful stream of water issuing from the side of a wall about thirty feet high, and which fell on a broken surface of stone, and was afterwards entirely lost to view.

Having passed a few yards beyond this beautiful sheet of water, so as to reach the end of the avenue, the party returned about one hundred yards, and passing over a considerable mass of stone, entered another, but smaller avenue to the right, which carried them south, through a third, of an uncommonly black hue, somewhat more than a mile; when they ascended a very steep hill about sixty yards, which

conducted them to within the walls of the fourth city. It is not inferior to the second; having an arch which covers at least six acres. In this last avenue, the extremity of which cannot be less than four miles from the chief city, and ten from the mouth of the cavern, are upwards of twenty large piles of salt-petre earth on the one side, and broken lime-stone heaped up on the other, evidently the work of human hands,

From the course of his needle, the Doctor expected that this avenue would have led circuitously to the chief city; but was much disappointed when he reached the extremity, at a few hundred yards distance from the fourth city. In retracing his steps, not having paid a due attention to mark the entrances of the different avenues, he was greatly bewildered, and once completely lost himself for nearly fifteen or twenty minutes. Thus, faint and wearied, he did not reach the chief area till ten at night; but was still determined to explore the cavern so long as his light should last. Having entered the fifth and last avenue from the chief area, and proceeded south-east about nine hundred yards, he came to the fifth area, the arch of which covers upwards of four acres of level ground, strewed with lime-stones, and having fire-beds of an uncommon size, surrounded with brands of cane, interspersed. Another avenue on the opposite side, led to one of still greater capacity, the walls or sides of which were more perfect than any that had been noticed, running almost due south for nearly a mile and a half, and being very level and straight, with an elegant arch. While the Doctor was employed, at the extremity of this avenue, in sketching a plan of the cave, one of his guides, who had strayed to a distance, called on him to follow. Leaving the other guide, he was led to a vertical passage, which opened into a chamber at least 1800 feet in circumference, and the centre of the arch of which was 150 feet in height.

It was past midnight when he entered this chamber of eternal darkness; and when he reflected on the different avenues through which he had passed since he had penetrated the cave at eight in the morning, and now found himself buried several miles in the dark recesses of this awful cavern—the grave, perhaps, of thousands of human beings—he felt a shivering horror. The avenue, or passage, which led

from it was as large as any he had entered; and it is uncertain how far he might have travelled had his lights not failed him. All those who have any knowledge of this cave, he observes, conjecture that Green River, a stream navigable several hundred miles, passes over three of its branches.

After a lapse of nearly an hour, he descended by what is called the "passage of the chimney," and joined the other guide. Thence returning to the chief area or city, where the lamps were trimmed for the last time, he entered the spacious avenue which led to the second hoppers. Here he met with various curiosities, such as spars, petrifactions, &c.; and these he brought away, together with a *mummy* which was found at the second hoppers. He reached the mouth of the cave about three in the morning, nearly exhausted with nineteen hours of constant fatigue. He nearly fainted on leaving it, and on inhaling the vapid air of the atmosphere, after having so long breathed the pure air occasioned by the nitre of the cave. His pulse beat stronger when withinside, but not so quick as when on the surface.

Here the Doctor observes that he has hardly described half the cave, not having named the avenues between its mouth and the second hoppers. This part of his narrative is of equal interest with what has been already given. He states that there is a passage in the main avenue, upwards of nine hundred feet from the entrance, like that of a trap-door. By sliding aside a large flat stone, you can descend sixteen or eighteen feet in a very narrow defile, where the passage comes on a level, and winds about in such a manner, as to pass under the main passage without having any communication with it, at length opening into the main cave by two large passages just beyond the second hoppers. This is called the "glauber-salt room," from salts of that kind being found there. Next come the sick room, the bat-room, and the flint-room, together with a winding avenue, which, branching off at the second hoppers, runs west and south-west for more than two miles. It is called the "haunted chamber," from the echo within: its arch is very beautifully incrusted with lime-stone spar; and in many places the columns of spar are truly elegant, extending from the ceiling to the floor. Near the centre of this arch is a dome, apparently fifty feet high, hung in rich drapery,

festooned in the most fanciful manner, for six or eight feet from the hangings, and in colours the most rich and brilliant. By the reflection of one or two lights, the columns of spar and the stalactites have a very romantic appearance. Of this spar a large cellar, called "Wilkins' armed chair," has been formed in the centre of the avenue, and encircled with many smaller ones. The columns of spar, fluted and studded with knobs of spar and stalactites; the drapery of various colours superbly festooned, and hung in the most graceful manner; these are shown with the greatest brilliancy by the reflection of the lamps.

In the vicinity of the "haunted chamber," the sound of a cataract was heard; and at the extremity of the avenue was a reservoir of water, very clear and grateful to the taste, apparently having neither inlet nor outlet. Here the air, as in many other parts of the cave, was pure and delightful. Not far from the reservoir, an avenue presented itself, within which were several columns of the most brilliant spar, sixty or seventy feet in height, and almost perpendicular, standing in basins of water; which, as well as the columns, the Doctor observes, surpass, in splendour and beauty, every similar work of art he had ever seen.

Returning by a beautiful pool of water, the Doctor came to the second hoppers, where he had fonnd the mummy before alluded to. It had been removed from another cave, for preservation, and was presented to him by his friend Mr. Wilkins, together with the apparel, jewels, music, &c. with which it was accompanied. It has since been placed in the Washington museum, the proprietor of which thinks it probable that this mummy is as ancient as the immense mounds of the western country, which have so much astonished the world.

GROTTO OF ANTIPAROS.

[*See Plate, No.* 24.]

ANTIPAROS, one of the Cyclades, is situated in the Ægean Sea, or Grecian Archipelago. It is a small island, about sixteen miles in circumference, and lies two miles to the west of the celebrated Paros, from which circumstance it derives its name, *anti* in the Greek language signifying *opposite to.* Its singular and most interesting grotto, though so inferior in size to the cavern in Kentucky, has

attracted the attention of an infinite number of travellers. The entrance to this superb grotto is on the side of a rock, and is a large arch, formed of craggy stones, overhung with brambles and creeping plants, which bestow on it a gloominess at once awful and agreeable. Having proceeded about thirty paces within it, the traveller enters a low narrow alley, surrounded on every side by stones, which, by the light of torches, glitter like diamonds; the whole being covered and lined throughout with small crystals, which give by their different reflections, a variety of colours. At the end of this alley or passage, having a rope tied round his waist, he is led to the brink of an awful precipice, and is thence lowered into a deep abyss, the gloom pervading which makes him regret the "alley of diamonds" he has just quitted. He has not as yet, however, reached the grotto, but is led forward about forty paces, beneath a roof of rugged rocks, amid a scene of terrible darkness, and at a vast depth from the surface of the earth, to the brink of another precipice, much deeper and more awful than the former.

Having descended this precipice, which is not accomplished without considerable difficulty, the traveller enters a passage, the grandeur and beauty of which can be but imperfectly described. It is one hundred and twenty feet in length, about nine feet high, and in width seven, with a bottom of a fine green glossy marble. The walls and arched roof are as smooth and polished as if they had been wrought by art, and are composed of a fine glittering red and white granite, supported at intervals by columns of a deep blood-red shining porphyry, which, by the reflection of the lights, presents an appearance inconceivably grand. At the extremity of this passage is a sloping wall, formed of a single mass of purple marble, studded with sprigs of rock crystal, which, from the glow of the purple behind, appear like a continued range of amethysts.

Another slanting passage, filled with petrifactions, representing the figures of snakes and other animals, and having towards its extremity two pillars of beautiful yellow marble, which seem to support the roof, leads to the last precipice, which is descended by means of a ladder. The traveller, who has descended to the depth of nearly one thousand five hundred feet beneath the surface, now enters



No. 24.—Grotto of Antiparos.



No. 25.—Devil's Peak, Derbyshire.





the magnificent grotto, to procure a sight of which he has endured so much fatigue. It is in width three hundred and sixty feet; in length three hundred and forty; and in most places one hundred and eighty in height. By the aid of torch-light, he finds himself beneath an immense and finely-vaulted arch, overspread with icicles of white shining marble, many of them ten feet in length, and of a proportionate thickness. Among these are suspended a thousand festoons of leaves and flowers, of the same substance, but so glittering as to dazzle the sight. The sides are planted with petrifactions, also of white marble, representing trees; these rise in rows one above the other, and often enclose the points of the icicles. From them also hang festoons, tied as it were one to another, in great abundance; and in some places rivers of marble seem to wind through them. In short, these petrifactions, the result of the dripping of water for a long series of ages, nicely resemble trees and brooks turned to marble. The floor is paved with crystals of different colours, such as red, blue, green, and yellow, projecting from it, and rendering it rugged and uneven. These are again interspersed with icicles of white marble, which have apparently fallen from the roof, and are there fixed. To these the guides fasten their torches; and the glare of splendor and beauty which results from such an illumination, may be better conceived than described.

To the above lively description we subjoin an extract from the one given by Dr. Clarke, a learned traveller, who visited this celebrated grotto in 102.

"The mode of descent is by ropes, which, on the different declivities, are either held by the guides, or are joined to a cable which is fastened at the entrance around a stalactite pillar. In this manner, we were conducted, first down one declivity, and then down another, until we entered the spacious chambers of this truly enchanted grotto. The roof, the floor, the sides of a whole series of magnificent caverns, were entirely invested with a dazzling incrustation as white as snow. Columns, some of which were five-and-twenty feet in length, pended in fine icicle forms above our heads: fortunately some of them are so far above the reach of the numerous travellers, who during many ages, have visited this place, that no one has been able to injure or remove them. Others extended from

the roof to the floor, with diameters equal to that of the mast of a first-rate ship of the line. The incrustations of the floor, caused by falling drops from the stalactites above, had grown up into dendritic and vegetable forms, which first suggested to Tournefort the strange notion of his having here discovered the vegetation of stones. Vegetation itself has been considered as a species of crystallization; and as the process of crystallization is so surprisingly manifested by several phænomena in this grotto, some analogy may perhaps be allowed to exist between the plant and the stone; but it cannot be said, that a principle of life existing in the former has been imparted to the latter. The last chamber into which we descended surprised us more by the grandeur of its exhibition than any other. Probably there are many other chambers below this, yet unexplored, for no attempt has been made to penetrate further: and, if this be true, the new caverns, when opened, would appear in perfect splendour, unsullied, in any part of them, by the smoke of torches, or by the hands of intruders.

CAVERNS IN GERMANY AND HUNGARY,

CONTAINING FOSSIL BONES.

Among the most remarkable of these caverns are those of Gaylenreuth, on the confines of Bayreuth. The opening to these, which is about seven feet and a half high, is at the foot of a rock of limestone of considerable magnitude, and in its eastern side. Immediately beyond the opening is a magnificent grotto, of about three hundred feet in circumference, which has been naturally divided by the form of the roof into four caves. The first is about twenty-five feet long and wide, and varies in height from nine to eighteen feet, the roof being formed into irregular arches. Beyond this is the second cave, about twenty-eight feet long, and of nearly the same width and height with the former.

A low and very rugged passage, the roof of which is formed of projecting pieces of rocks, leads to the third grotto, the opening into which is a hole three feet high,

and four feet wide. This grotto is more regular in its form, and is about thirty feet in diameter, and nearly round; its height is from five to six feet. It is very richly and fantastically adorned by the varying forms of its stalactitic hangings. The floor is also covered with a wet and slippery glazing, in which several teeth and jaws appear to have been fixed.

From this grotto commences the descent to the inferior caverns. Within only about five or six feet an opening in the floor is seen, which is partly vaulted over by a projecting piece of rock. The descent is about twenty feet. This cavern is about thirty feet in height, about fifteen feet in width, and nearly circular; the sides, roof, and floor, displaying the remains of animals. The rock itself is thickly beset with teeth and bones, and the floor is covered with a loose earth, the evident result of animal decomposition, and in which numerous bones are imbedded.

A gradual descent leads to another grotto, which, with its passage, is forty feet in length, and twenty feet in height. Its sides and top are beautifully adorned with stalactites. Nearly twenty feet further is a frightful gulf, the opening of which is about fifteen feet in diameter; and, upon descending about twenty feet, another grotto, about the same diameter with the former, but forty feet in height, is seen. Here the bones are dispersed about; and the floor, which is formed of animal earth, has great numbers of them imbedded in it. The bones which are here found, seem to be of different animals; but in this, as well as in the former caverns, perfect and unbroken bones are very seldom found. Sometimes a tooth is seen projecting from the solid rock, through the stalactitic covering, showing that many of these wonderful remains may here be concealed. A specimen of this kind has been preserved, and is rendered particularly interesting, by the first molar tooth of the lower jaw, with its enamel quite perfect, rising through the stalactitic mass which invests the bone. In this cavern the stalactites begin to be of a larger size, and of a more columnar form.

Passing on through a narrow opening in the rock, a small cave, seven feet long, and five feet high, is discovered; another narrow opening leads to another small cave; from which a sloping descent leads to a cave twenty-five feet in

height, and about half as much in its diameter, in which is a truncated columnar stalactite, eight feet in circumference.

A narrow and most difficult passage, twenty feet in length, leads from this cavern to another, five-and-twenty feet in height, which is every where beset with teeth, bones, and stalactitic projections. This cavern is suddenly contracted, so as to form a vestibule of six feet wide, ten long, and nine high, terminating in an opening close to the floor, only three feet wide and two high, through which it is necessary to writhe, with the body on the ground. This leads into a small cave, eight feet high and wide, which is the passage into a grotto, twenty eight feet high, and about three-and-forty feet long and wide. Here the prodigous quantity of animal earth, the vast number of teeth, jaws, and other bones, and the heavy grouping of the stalactites, produce so dismal an appearance, as to become a perfect model of a temple for a god of the dead. Here hundreds of cart-loads of bony remains might be removed, pockets might be filled with fossil teeth, and animal earth was found to reach to the utmost depth to which the workmen dug. A piece of stalactite, being here broken down, was found to contain pieces of bones, within it, the remnants of which were left imbedded in the rock.

From this principal cave is a very narrow passage, terminating in the last cave, which is about six feet in width, fifteen in height, and the same in length. In this cave were no animal remains, and the floor was the naked rock.

Thus far only could these natural sepulchres be traced; but there is every reason to suppose, that these animal remains were disposed through a greater part of this rock.

Whence this immense quantity of the remains of carnivorous animals could have been collected, is a question which naturally arises; but the difficulty of answering it appears to be almost insurmountable.

THE GROTTA DEL CANE.

This name has been given to a small cavern between Naples and Pozzuoli, on this account, that if a dog be brought into it, and his nose held to the ground, a difficulty of respiration instantly ensues, and he loses all sensation, and even life, if he be not speedily removed into purer air. There are other grottoes endowed with the same deletereous quality, especially in volcanic countries; and the pestiferous vapours they exhale are quickly fatal both to animals and man, though they do not offer to the eye the slightest indication of their presence. These vapours are, however, for the greater part temporary; while that of the Grotta del Cane is perpetual, and seems to have produced its deadly effects even in the time of Pliny. A man standing erect within does not suffer from it, the mephitic vapour rising to a small height only from the ground. It may, therefore, be entered without danger.

The smoke of a torch extinguished in this vapour, or gas, sinks downward, assumes a whitish colour, and passes out at the bottom of the door. The reason of this is, that the fumes which proceed from the torch mix more readily with the gas than with the atmospherical air. It has been supposed, that the mischievous effects of the vapour were the result of the air being deprived of its elasticity; but it has been clearly demonstrated by M. Adolphus Murray, that they are solely to be attributed to the existence of carbonic acid gas.

The person who is the keeper, or guide, at the grotto, and who shows to strangers the experiment of the dog for a gratuity, takes the animal, when he is half dead and panting, into the open air, and then proceeds to throw him into the neighbouring lake of Agnano, thus insinuating that this short immersion in the water is necessary to his complete restoration. This, however, is a mere trick, to render the experiment more specious, and to obtain a handsome present from the credulous, the atmospherical air alone sufficing for that purpose.

The celebrated naturalist, the Abbe Spalanzani, projected a regular series of experiments on the mephitic

vapour of this grotto, from a persuasion that they would tend to throw a new light on physiology and natural philosophy. Being, however, prevented from undertaking this, by his duties as a professor, his friend, the Abbe Breislak, who resided near the spot, engaged in the task; and the following is an abstract of his learned memoir on this subject.

It is well known, the Abbe observes, that the mephitic vapour occupies the floor of a small grotto near the lake Agnano, a place highly interesting to naturalists from the phenomena its environs present, and the hills within which it is included. This grotto is situated on the southeast side of the lake at a little distance from it. Its length is about twelve feet, and its breadth from four to five. It appears to have been originally a small excavation, made for the purpose of obtaining puzzolana, an earth which, being applied as mortar, becomes a powerful cement. In the sides of the grotto, among the earthy volcanic matters, are found pieces of lava, of the same kind with those, which are met with scattered near the lake.

The Abbe is persuaded that, if new excavations were to be made in the vicinity of the grotto, at a level with its floor, or a little lower, the same mephitic vapour would be found; and thinks it would be curious to ascertain the limits of its extent. It would also be advantageous to physical observations, if the grotto were to be somewhat enlarged, and its floor reduced to a level horizontal plane, by sinking it two or three feet, and surrounding it by a low wall, with steps at the entrance. In its present state it is extremely inconvenient for experiments, and the inclination of the ground towards the door causes a great part of the vapour, from the effect of its specific gravity, to make its way out close to the ground.

When the narrow limits of this place are considered, and the small quantity of the vapour which has rendered it so celebrated, there cannot be any doubt but that it has undergone considerable changes; since it does not appear probable that Pliny refers to the present confined vapour only, when, in enumerating many places from which a deadly air exhaled, he mentions the territory of Pozzuoli. The internal fermentations by which it is caused are certainly much diminished in the vicinity of the lake Agnano.

The water near its banks is no longer seen to bubble up, from the disengagement of a gas, as it appears from accounts not of very remote antiquity, to have done. The borders of the lake were attentively examined by the Abbe, when its waters were at the highest, and after heavy rains; but he could never discover a single bubble of air. A number of aquatic insects which sport on the surface, may at first sight occasion some deception; but a slight observation soon detects the error. If, therefore, we do not suppose those authors who have described the ebullition of the water near the banks of the lake Agnano to have been deceived, it must at least be confessed, that this phenomenon has now ceased. The quantity of the sulphureous vapours which rise in the contiguous stoves, called the stoves of St. Germano, must likewise be greatly diminished from what it anciently was: for, adjoining to the present stoves, we still find the remains of a spacious ancient fabric, with tubes of terra cotta inserted in the walls, which, by their direction, show for what purpose they were intended. It appears certain, that this was a building in which, by the means of pipes properly disposed, the vapours of the place were introduced into different rooms, for the use of patients. To these ruins, however, the vapours no longer extend; so that, if this edifice had remained entire, it could not have been employed for the purpose for which it was intended. The veins of pyrites which produced the more ancient conflagrations of the Phlegrean fields, between Naples and Cuma, and which, in some places are entirely consumed, approach their total extinction. To proceed to the experiments within the grotto.

The object of the first was to determine the height of the mephitic vapour at the centre of the grotto, that is, at the intersection of the line of its greatest length with that of its greatest breadth. This height varies according to the different dispositions and temperatures of the atmosphere, the diversity of winds, and the accidental variations which take place in the internal fermentations by which the vapour is produced. It may, however, be estimated, at a mean, at nearly nine English inches.

The second set of experiments regarded the degree of heat on entering into the mephitis: it was slightly sensible

in the feet and lower part of the legs; notwithstanding which, on taking out of the vapour several substances which had remained in it for a long time, such as stones, leaves, the carcases of animals, &c. the Abbe found that these were of the same temperature with the atmospheric air. Feeling in his body a slight degree of heat, which he could not perceive in the substances removed from the mephitic vapour, he was led by comparison to conclude, that the temperature of the latter was the same with the atmospherical air, agreeably to the principles of Dr. Crauford. He was, however, mistaken; for, in subsequent experiments, he found a very distinct degree of heat. He was now provided with a thermometer, his former one having been broken, and, having suspended it at the aperture of the grotto, three feet above the surface of the vapour, found the mercury to stand at from sixty-two to sixty-four degrees of Fahrenheit; but, on placing the ball on the ground so as to immerse it in the vapour, the mercury rose to eighty, and even eighty-two degrees. That the substances taken out of the mephitis did not exhibit this diversity of temperature, was, he thinks, owing to the quantity of humidity with which they are always loaded, and which produces on their surface a constant evaporation. He was the more particular in repeating these experiments, because the naturalists who had, before him, made similar ones in the GROTTA DEL CANE, had not observed the vapour to produce any effect on the mercury in the thermometer.

Thirdly. He repeated for his own satisfaction, the usual experiments made by naturalists, with the tincture of turnsol, lime-water, the crystallizations of alkalis, the absorption of water, and the acidulous taste communicated to it; which prove, beyond all doubt, the existence of fixed air, or carbonic acid gas, in the vapour of the grotto. He ascertained that it was not formed of fixed air alone, as might have been conjectured; but that the relative quantities of the different gasses which compose its mephitic air, are as follow:—In one hundred parts, there are ten of vital air, or oxygenous gas; forty of fixed air, or carbonic acid gas; and fifty of phlogisticated air, or azotic gas.

Fourthly. The phenomena of magnetism and electricity were investigated by the Abbe in this grotto. With respect

to the former, there was not any new appearance: the magnetic needle, being placed on the ground, and consequently immersed in the mephitis, rested in the direction of its meridian; and, at the approach of a magnetized bar, exhibited the usual effects of attraction and repulsion, in proportion as either pole was presented. As to the latter, electricity, it was impossible to make the experiments within the mephitis, not because this kind of air is a conductor of the electric fluid, as has been imagined, but because the humidity by which it is constantly accompanied, disperses the electric matter; and this, not being collected in a conductor, cannot be rendered sensible. He attempted several times to fire inflammable gas, with electric sparks, in the mephitic vapour, by means of the conductor of the electrophus; but, notwithstanding his utmost endeavours to animate the electricity, he could never obtain a single spark, the non-conductor becoming a conductor the moment it entered into the mephitis, on account of the humidity which adhered to its surface.

Fifthly. His latest experiments were directed to the theory of the combustion of bodies. He first endeavoured to ascertain whether those spontaneous inflammations that result from the mixture of concentrated acids with essential oils, could be obtained within the grotto. He placed on the ground a small vessel, in such a situation that the mephitis rose six inches above its edges, employing oil of turpentine, and the vitriolic and nitrous acids: the same inflammation, accompanied by a lively flame, followed, as would have taken place in the open atmospheric air. The dense smoke which always accompanies these inflammations, being attracted by the humidity of the mephitis, presented its undulations to the eye, and formed a very pleasing object. As he had put a considerable quantity of acid in the vessel, he repeatedly poured in a little of the oil, and the flame appeared in the mouth of the vessel fifteen times successively. The oxygenous principle contained in the acids, and with which the nitrous acid principally abounds, undoubtedly contributed to the production and duration of this flame, though enveloped in an atmosphere inimical to inflammation.

The Abbe had, in the district of Latera, observed that in a mephitis of hydrogenous sulphurated or hepatic gas

a slow combustion of phosphorus took place, with the same resplendence as in the atmospheric air. On the present occasion, his first experiment, in the mephitis of Agnano, was made with common phosphoric matches, five of which he broke, holding them to the ground, and consequently immersed in the mephitis. They produced a short and transient flame, which became extinguished the moment it was communicated to the wick of a candle. His second experiment was as follows:—He placed on the ground, within the grotto, a long table, in such a manner as that one extremity was without the mephitis, while the other, and four-fifths of its length, were immersed in it. Along this table he laid a train of gun-powder, beginning from the end without the mephitis; and, at the other end, which was immersed in it to the depth of seven inches, he placed, adjoining to the gun-powder, a cylinder of phosphorus, eight lines in length. The gun-powder, without the mephitis, being fired, the combustion was soon communicated to the other extremity of the train, and to the phosphorus, which took fire with decrepitation, burned rapidly with a bright flame, slightly coloured with yellow and green, and left on the wood a black mark, as of charcoal. The combustion lasted nearly two minutes, when the whole phosphoric matter was consumed.

In succeeding experiments not any alteration was perceptible in the flame, or manner of burning, of the lighted phosphorus, either at the moment of its entrance into the mephitis, or during its continuance in it. When suddenly withdrawn, it ignited gun-powder equally well. Hence the Abbe deduces, that the mephitic gas of the Grotta del Cane, however it may be utterly unfit for the respiration of animals, and for the inflammation of common combustible substances, readily allows that of phosphorus, which not only burns in it, but emits, as usual, luminous sparks.

THE GREAT CAVERN OF GUACHARO,

IN SOUTH AMERICA.*

In a country where the people love what is marvellous, a cavern that gives birth to a river, and is inhabited by thousands of nocturnal birds, the fat of which is employed in the Missions to dress food, is an everlasting object of conversation and discussion. Scarcely has a stranger arrived at Cumana, when he is told of the stone of Araya for the eyes; of the labourer of Arenas who suckled his child; and of the CAVERN OF GUACHARO; which is said to be several leagues in length; till he is tired of hearing of them.

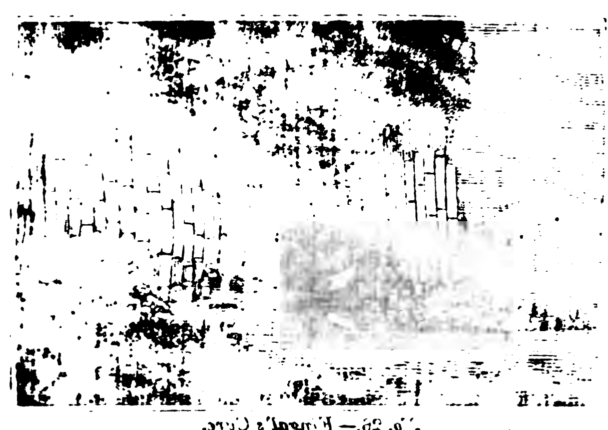
The Cueva del Guacharo is pierced in the vertical profile of a rock. The entrance is toward the south, and forms a vault eighty feet broad, and seventy-two feet high. The rock, that surmounts the grotto, is covered with trees of gigantic height. The mammee-tree, and the genipa with large and shining leaves, raise their branches vertically towards the sky; while those of the courbaril and the erythrina form, as they extend themselves, a thick vault of verdure. Plants of the family of pothos with succulent stems, oxalises, and orchideæ of a singular structure, rise in the driest cliffs of the rocks; while creeping plants, waving in the winds, are interwoven in festoons before the opening of the cavern. We distinguished in these festoons a bignonia of a violet blue, the purple dolichos, and for the first time that magnificent olandra, the orange flower of which has a fleshy tube more than four inches long. The entrances of grottoes, like the view of cascades, derive their principal charm from the situation, more or less majestic, in which they are placed, and which in some sort determines the character of the landscape. What a contrast between the Cueva of Caripe, and those caverns of the North crowned with oaks and gloomy larch-trees!

But this luxury of vegetation embellishes not only the outside of the vault, it appears even in the vestibule of the grotto. We saw with astonishment plantain-leaved heliconias eighteen feet high, the praga palm-tree, and arbor-

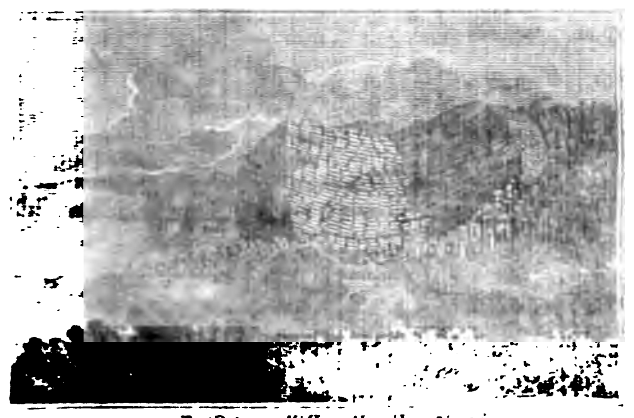
* Abridged from the Personal Narrative of Humboldt, vol. iii.

escent arums, follow the banks of the river even to those subterranean places. The vegetation continues in the cave of Caride, as in those deep crevices of the Andes, half excluded from the light of day; and does not disappear, till, advancing into the interior, we reach thirty or forty paces from the entrance. We measured the way by means of a cord: and we went on about four hundred and thirty feet, without being obliged to light our torches.

Day-light penetrates into this region, because the grotto forms but one single channel, which keeps the same direction from south-east to north-west. Where the light begins to fail, we heard from afar the hoarse sounds of the nocturnal birds, sounds which the natives think belong exclusively to those subterraneous places. The guacharo is of the size of our fowls, has the mouth of the goatsuckers and procnias, and the port of those vultures, the crooked beak of which is surrounded with stiff silky hairs. It forms a new genus, very different from the goatsucker by the force of its voice, by the considerable strength of its beak, containing a double tooth, by its feet without the membranes that unite the anterior phalanxes of the claws. In its manners it has analogies both with the goatsuckers and the alpine crow. The plumage of the guacharo is of a dark bluish-grey, mixed with small streaks and specks of black. It is difficult to form an idea of the horrible noise occasioned by thousands of these birds in the dark part of the cavern, and which can only be compared to the croaking of our crows, which, in the pine forests of the north, live in society, and construct their nests upon trees, the tops of which touch each other. The shrill and piercing cries of the guacharoes strike upon the vaults of the rocks, and are repeated by the echo in the depth of the cavern. The Indians shewed us the nests of these birds, by fixing torches to the end of a long pole. These nests were fifty or sixty feet high above our heads, in holes in the shape of funnels, with which the roof of the grotto is pierced like a sieve. The noise increased as we advanced, and the birds were affrighted by the light of the torches of copal. When this noise ceased around us, we heard at a distance the plaintive cries of the birds roosting in other ramifications of the cavern. It seemed as if these bands answered each other alternately.



No. 26.—Fingal's Cave.



No. 27.—...ing Pillars at Staffa.



No. 26.—Fingal's Cave.



No. 27.—Bending Pillars at Staffa.

The Indians enter into the Cueva del Guacharo once a-year, near midsummer, armed with poles, by means of which they destroy the greater part of the nests. At this season several thousands of birds are killed; and the old ones, to defend their brood, hover around the heads of the savage Indians, uttering terrible cries, which would appal any heart but that of man in an untutored state.

We followed, as we continued our progress through the cavern, the banks of the small river which issued from it, and is from twenty-eight to thirty feet wide. We walked on the banks, as far as the hills formed of calcareous incrustations permitted us. When the torrent winds among very high masses of stalactites, we were often obliged to descend into its bed, which is only two feet in depth. We learnt with surprise, that this subterraneous rivulet is the origin of the river Caripe, which, at a few leagues distance, after having joined the small river of Santa Maria, is navigable for canoes. It enters into the river Areo under the name of *Canno de Terezen*. We found on the banks of the subterraneous rivulet a great quantity of palm-tree wood, the remains of trunks, on which the Indians climb to reach the nests hanging to the roofs of the cavern. The rings, formed by the vestiges of the old footstalks of the leaves, furnish as it were the footsteps of a ladder perpendicularly placed.

The grotto of Caripe preserves the same direction, the same breadth, and its primitive height of sixty or seventy feet, to the distance of 1458 feet, accurately measured. I have never seen a cavern in either continent, of so uniform and regular a construction. We had great difficulty in persuading the Indians to pass beyond the outer part of the grotto, the only part which they annually visit to collect the fat. The whole authority of *los padres* was necessary, to induce them to advance as far as the spot where the soil rises abruptly at an inclination of sixty degrees, and where the torrent forms a small subterraneous cascade.* The natives connect mystic ideas with this cave, inhabited by nocturnal birds; they believe, that the

* We find this phenomenon of a subterranean cascade, but on a much larger scale, in England, at Yordas cave, near Kingsdale, in Yorkshire.

souls of their ancestors sojourn in the deep recesses of the cavern. "Man," say they, "should avoid places which are enlightened neither by the Sun nor by the Moon." To go and join the guacharoes, is to rejoin their fathers, is to die. The magicians and the poisoners perform their nocturnal tricks at the entrance of the cavern, to conjure the chief of the evil spirits.

At the point where the river forms the subterraneous cascade, a hill covered with vegetation, which is opposite the opening of the grotto, presents itself in a very picturesque manner. It appears at the extremity of a straight passage, 240 toises in length. The stalactites, which descend from the vault, and which resemble columns suspended in the air, display themselves on a back-ground of verdure. The opening of the cavern appeared singularly contracted, when we saw it about the middle of the day, illumined by the vivid light reflected at once from the sky, the plants, and the rocks. The distant light of day formed somewhat of magical contrast with the darkness that surrounded us in those vast caverns. We climbed, not without some difficulty, the small hill, whence the subterraneous rivulet descends. We saw that the grotto was perceptibly contracted, retaining only forty feet in its height; and that it continued stretching to the northeast, without deviating from its primitive direction, which is parallel to that of the great valley of Caripe.

The missionaries, with all their authority, could not prevail on the Indians to penetrate farther into the cavern. As the vault grew lower, the cries of the guacharoes became more shrill. We were obliged to yield to the pusillanimity of our guides, and trace back our steps. We followed the course of the torrent to go out of the cavern. Before our eyes were dazzled with the light of day, we saw without the grotto, the water of the river sparkling amid the foilage of the trees that concealed it. It was like a picture placed in the distance, and to which the mouth of the cavern served as a frame. Having at length reached the entrance, and seated ourselves on the bank of the rivulet, we rested after our fatigues. We were glad to be beyond the hoarse cries of the birds, and to leave a place where darkness does not offer even the charms of silence and tranquility.

GRAND STAFFA CAVERN;

OR, FINGAL'S CAVE.

[*See Plates, No.* 26, 27.]

By far the best description of this very extraordinary feature of the most wonderful island of the Hebrides, the whole of which constitutes as singular and romantic a spot as is any where to be found, has been given by Sir Joseph Banks, from whose more detailed account we extract the following particulars.

Staffa, about seven miles N. N. E. of Jona, and equi-distant westward from the shores of Mull, about one mile in length, and half a mile in breadth, is noted for the basaltic pillars which support the major part of the island, and for the magnificent spectacle afforded by the Cave of Fingal, one of the most splendid works of nature.

Notwithstanding the contiguity of this island to Mull and Jona, and the numerous vessels which navigate these seas, this wonderful Island was unknown to the world in general, and even to most of the neighbouring islanders, until near the close of the last century, when Sir Joseph, then on his voyage to Iceland, in consequence of information received in the sound of Jona from some gentlemen of Mull, was induced to sail thither. It is, indeed, slightly mentioned by Buchanan; but assuredly was not equally dead to fame at the time the Norwegians had sway in these parts; for from them it derives its name of Staffa.

The basaltic pillars stand in natural colonnades, mostly above fifty feet high, in the south-western part, upon a firm basis of solid unshapen rock; above these, the stratum, which reaches to the soil of the island, varies in thickness, in proportion to the distribution of the surface into hill and valley. The pillars are of three, four, and more sides; but the number of those with five and six exceeds that of the others; one of seven sides, measured by Sir Joseph, was four feet five inches in diameter.

On the west side of Staffa is a small bay, the spot where boats usually land. In this neighbourhood occurs the first

group of pillars; they are small, and instead of being placed upright, are recumbent on their sides, and form a segment of a circle. Further on is a small cave, above which pillars again are seen, of somewhat larger dimensions, which incline in all directions; in one place in particular, a small mass of them much resembles the ribs of a ship. Beyond the cave is the first continued range of pillars, larger than the former, and opposite to them is a small island called Bhuachaile, (pronounced Boo sha-'lay,) or the Herdsman's Isle, separated from the main by a channel not many fathoms wide. The whole of this islet is composed of pillars without any strata above them; they are small, but by much the neatest formed of any in this quarter.

The first division of this islet, for at high water, it is divided into two parts, makes a kind of cone, the pillars converging together towards the centre. On the other side the pillars are in general recumbent; and in the front, next the main, the beautiful manner in which they are joined is visible from their even extremities; all these have their transverse sections exact, and their surfaces smooth; but with the larger pillars the reverse is the case, and they are cracked in all directions.

The main island opposite the Boo-sha-'lay, and thence towards the north-west, is entirely supported by ranges of pillars, pretty erect, which, although not apparently tall, from their not being uncovered to the base, are of large diameter; at their feet is an irregular pavement, made by the upper sides of such as have been broken off. This extends as far under the water as the eye can reach.

In proceeding along the shore, the superb cavern of Fingal appears, for such is the denomination given it by the Highlanders, to whom it is known. It is supported on each side by ranges of columns, and is roofed by the bottoms of such as have been broken away. From the interstices of the roof a yellow stalactitic matter has exuded, which precisely defines the different angles; and, varying the colour, tends to augment the elegance of its appearance. What adds to the grandeur of the scene, the whole cave is lighted from without, in such a manner, that the farthermost extremity is plainly distinguished; while the air within, being constantly in motion, owing to the flux and

reflux of the tides, is perfectly dry and wholesome, and entirely exempt from the damp vapours to which natural caverns are generally subject. The following are its dimensions:

	Feet.	Inch.
Length of the cave from the rock without	371	6
from the pitch of the arch	250	0
Breadth of ditto at the mouth	53	7
at the farther end	20	0
Height of the arch at the mouth	117	6
at the end	70	0
Height of an outside pillar	39	6
one at the north-west corner ..	54	0
Depth of water at the mouth	18	0
at the extremity	9	0

The cave runs to the rock in the direction by compass N. N. E.

The mind can hardly form an idea more magnificent than such a space—And, indeed, speaking of the general aspect of Staffa, Sir Joseph is led by his enthusiasm to make the following reflections:—"Compared to this, what are the cathedrals or the palaces built by men! mere models or playthings, imitations as diminutive as his works will always be when compared to those of nature. Where is now the boast of the architect! regularity, the only part in which he fancied himself to exceed his mistress, Nature, is here found in her possession, and here it has been left undescribed for ages. Is not this the school where the art was originally studied? And what has been added to this by the whole Grecian school? a capital to ornament the column of nature, of which they could execute a model only; and for that very capital they were obliged to a bush of Acanthus. How amply does nature repay those who study her wonderful works."

Such were his feelings, and in this way did he moralize, when proceeding along shore, and treading as it were, on another Giant's Causeway, he arrived at the mouth of the cave.

To the north-west are found the highest range of pillars. Here they are bare to their base, and the stratum beneath is visible, as it rises several feet above the water. The surface of it is rough, with frequent large pieces of stone

sticking in it, as if half immersed. The base, when broken appears to be composed of many heterogeneous parts, and much resembles lava. Many of the floating stones are of a similar substance with the pillars, a coarse basaltes, less beautiful than that of the Giant's Causeway: the colour is a dirty brown. The whole of this stratum dips gradually to the south-east.

The thickness of the stratum of lava-like matter below the pillars, the height of the pillars, and the thickness of the superincumbent stratum at three different places westward of the mouth of the cave, beginning with the corner pillar of the cave, are described as under by Sir Joseph Banks.

	Feet.	In.	Feet.	In.	Feet.	In.
Stratum below	11	0	17	1	19	8
Height of pillars	54	0	50	0	55	1
Stratum above	61	6	51	1	54	7

The Stratum above the columns is uniformly the same, consisting of numberless small pillars, bending and inclining in all directions, sometimes so irregularly, that the stones can only be said to have an inclination to assume a columnar form; in others more regularly; but never breaking into, or disturbing the stratum of large pillars, whose tops keep every where an uniform line. On the opposite side of the island is a cavern, called Oua-na-scarve, or the Cormorant's cave; here the stratum under the pillars is lifted up very high, and the pillars are considerably less than at the north-west side. Beyond, a bay cuts deep into the island, rendering it not more than a quarter of a mile across. On the sides of this bay, especially beyond a little valley, which almost divides the island, are two stages of small pillars, with a stratum between, exactly resembling that above, formed of innumerable little pillars shaken out of their places, and leaning in all directions. Beyond this, the pillars totally cease. The rock is of a dark-brown stone, without regularity, from the bay along the south-east end of the island; beyond which, a disposition to columnar formation is again manifested, extending from the west side, but in an irregular manner, to the bending pillars first described.

OTHER GROTTOES AND CAVERNS.

There are few countries which have not to boast of a variety of natural excavations; and these have, from their extent, structure, and the curious phenomena they exhibit, in the formation of petrifactions, &c. been at all times objects of popular attention. Among those particularly deserving of notice are the following:

The volcanic country bordering on Rome is peculiarly diversified by natural cavities of great extent and coolness, on which last account it is related by Seneca, that the Romans were accustomed to erect seats in their vicinity, to enjoy their refreshing chillness in the summer season. He gives a particular account of two such grottoes belonging to the villa of Vatia; and it was in a place of this kind that Tiberius was nearly destroyed while at supper. Its roof suddenly gave way, and buried several of his attendants in its ruins; which so alarmed the others, that they fled and abandoned the emperor, with the exception of Sejanus, who, stooping on his hands and knees, and covering the body of Tiberius with his own, received all the stones which fell at that part from the roof, insomuch that, although he himself sustained considerable injury, the emperor escaped unhurt.

The Grottoes of the Cevennes Mountains, in Lower Languedoc, are both numerous and extensive. The principal one is not to be explored without much precaution, and without a safe guide. The entrance, which is low and narrow, leads to a spacious amphitheatre, the petrifactions hanging from the roof of which have a most splendid effect by the light of torches. Hence the visitor has to descend to several chambers, one of which is named the Chamber of the Winds; another, of Echo; another, of the Cascade; another, again, of the Statue, &c.; on account of their exhibiting these different phenomena. In the grotto of Valori, at a small distance, the different natural curiosities which are to be found at every step, may be viewed at leisure, and without apprehension, as the visitor never loses sight of the light at the entrance, and is, therefore, not under any dread of returning in safety. Here he is gratified by a view of the most singular petrifactions,

representing flowers, fruits, bee-hives, and, in short, a variety of objects, in many of which the resemblance is nearly as accurate as if they had been sculptured.

In a wood, about five leagues from Besançon, in the province of France, called Franche Comte, an opening, formed by two masses of rock, leads to a cavern more than nine hundred feet beneath the level of the country. It is in width sixty feet, and eighty feet high, at the entrance, and exhibits withinside an oval cavity of one hundred and thirty-five feet in breadth, and one hundred and sixty-eight in length. To the right of the entrance is a deep and narrow opening, bordered with festoons of ice, which, distilling in successive drops on the bottom of the cavern, form a mass of about thirty feet in diameter. A similar one, but somewhat smaller, produced by the water which drips in less abundance from the imperceptible fissures in the roof, is seen on the left. The ground of the cavern is perfectly smooth, and covered with ice eighteen inches thick; but the top, on the outside, is a dry and stony soil, covered with trees, and on a level with the rest of the wood. The cold within this cavern is so great, that, however warm the external atmosphere may be at the time it is visited, it is impossible to remain in it for any continuance.

These natural ice-houses are not unfrequent in France and Italy, and supply this agreeable luxury at a very cheap rate. Thus, in the same province, in the vicinity of Vesoul, is a cavern which, in the hot season when it is eagerly sought, produces more ice in one day than can be carried away in eight. It measures thirty-five feet in length, and in width sixty. The large masses of ice which hang pendent from the roof, have a very pleasing effect. When mists are observed in this cavern, they are regarded by the neighbouring peasantry as infallible prognostics of rain; and it is worthy of observation, that although the water in the interior is always frozen in the summer, it becomes liquid in the winter season.

A grotto near Douse, also in Franche Comte, forms a similar ice-house, and is remarkable on account of the various forms of its congelations, which represent a series of columns, sustaining a curious vault, which appears to be carved with figures of men, animals, trees, &c.

The caverns of Gibralter are numerous, and several of them of a great extent. The one more particularly deserving attention is called St. Michael's Cave, situated on the southern part of the mountain. Its entrance is one thousand feet above the level of the sea, and is formed by a rapid slope of earth, which has fallen in at various periods, and which leads to a spacious hall, incrusted with spar, and apparently supported in the centre by a large stalactical pillar. To this succeeds a long series of caves, of difficult access. The passages leading from the one to the other are over precipices, which cannot be passed without the aid of ropes and scaling ladders. Several of these caves are three hundred feet beneath the upper one; but at this depth the smoke of the torches carried by the guides becomes so disagreeable, that the visitor is obliged reluctantly to give up the pursuit, and leave other caves unexplored. In these cavernous recesses, the process and formation of the stalactites is to be traced, from the flimsy quilt-like cone suspended from the roof, to the robust trunk of a pillar, three feet in diameter, which rises from the floor, and seems intended by nature to support the roof from which it originated.

The variety of forms which this matter takes in its different situations and directions, renders this subterraneous scenery strikingly grotesque, and in some places beautifully picturesque. The stalactites of these caves, when near the surface of the mountain, are of a brownish yellow colour; but, in descending towards the lower caves, they lose the darkness of their colour, which is by degrees shaded off to a pale yellow. Fragments are broken off, and, when wrought into different forms, and polished, are beautifully streaked and marbled.

About seven English miles from Adlersberg, in Carniola, is a remarkable cavern, named St. Magdalen's Cave. The road being covered with stones and bushes, is very painful; but the great fatigue it occasions is overbalanced by the satisfaction of seeing so extraordinary a cavern. The visitor first descends into a hole, where the earth appears to have fallen in for ten paces, when he reaches the entrance, which resembles a fissure caused by an earthquake, in a huge rock. The torches are here lighted, the cave being extremely dark. This wonderful natural ex-

cavation is divided into several large halls, and other apartments. The vast number of pillars by which it is ornamented give it a superb appearance, and are extremely beautiful: they are as white as snow, and have a semi-transparent lustre. The bottom is of the same materials; insomuch that the visitor may fancy he is walking beneath the ruins of some stately palace, amid noble pillars and columns, partly mutilated, and partly entire. Sparry icicles are every where seen suspended from the roof, in some places resembling wax tapers, which, from their radiant whiteness, appear extremely beautiful. All the inconvenience here arises from the inequality of the surface, which may make the spectator stumble while he is contemplating the beauties above and around him.

In the neighbourhood of the village of Szelitze, in Upper Hungary, there is a very singular excavation. The adjacent country is hilly, and abounds with woods, the air being cold and penetrating. The entrance into this cavern, fronting the south, is upwards of one hundred feet in height, and forty-eight in breadth, consequently sufficiently wide to receive the south wind, which here generally blows with great violence; but the subterraneous passages, which consist entirely of solid rock, winding round, stretch still farther to the south. As far as they have been explored, their height has been found to be three hundred feet, and their breadth about one hundred and fifty. The most inexplicable singularity, however, is, that in the midst of winter the air in this cavern is warm; and when the heat of the sun without is scarcely supportable, the cold within is not only very piercing, but so intense, that the roof is covered with icicles of the size of a large cask, which, spreading into ramifications, form very grotesque figures. When the snow melts in spring, the inside of the cave, where its surface is exposed to the south sun, emits a pellucid water, which congeals instantly as it drops, and thus forms the above icicles: even the water which falls from them on the sandy ground, freezes in an instant. It is observed, that the greater the heat is without, the more intense is the cold within; so that, in the dog-days, every part of this cavern is covered with ice. In autumn, when the nights become cold, the ice begins to dissolve, insomuch that, when the winter sets in, it is no longer to be

seen: the cavern then is perfectly dry, and has a mild warmth. It is, therefore, not surprising that swarms of flies, gnats, bats, owls, and even great numbers of foxes and hares, resort thither, as to their winter retreat, and remain there until the return of spring.

THE YANAR,

OR PERPETUAL FIRE.

CAPTAIN BEAUFORT, of the royal Navy, F. R. S. among the interesting details of his late survey of Karamania, or the South coast of Asia Minor, describes this curious phenomenon; and from his account the following particulars are extracted, as supplementary to the ample details of volcanoes already given.

Having perceived during the night a small but steady light among the hills, this was represented by the inhabitants as a *yanar*, or *volcanic light*; and on the following morning curiosity led him to visit the spot. In the inner corner of a ruined building he came to a wall, so undermined as to leave an aperture of about three feet in diameter, and shaped like the mouth of an oven. From this aperture the flame issued, giving out an intense heat, but without producing any smoke on the wall; and although several small lumps of caked soot were detached from the neck of the opening, the walls were scarcely discoloured. Trees, brushwood, and weeds, grew close around this little crater; a small stream trickled down the hill in its vicinity; and the ground did not appear to feel the effect of its heat at more than a few yards distance. Not any volcanic productions were to be perceived near to it; but at a short distance, lower down on the side of the hill, was another hole or aperture, which had apparently been at some remote period the vent of a similar flame. It was asserted, however, by the guide, that, in the memory of the present race of inhabitants, there had been but one such volcanic opening, and that its size and appearance had been constantly the same. He added, that it was never accompanied by earthquakes or noises; and that it did not eject either stones, smoke, or noxious vapours; but that its brilliant and perpetual flame could not be quenched by any quan-

tity of water. At this flame, he observed, the shepherds were in the habit of cooking their food.

This phenomenon appears to Captain Beaufort to have existed for many ages, and he is persuaded that it is the spot to which Pliny alludes in the following passage:—"Mount Chimera, near Phaselis, emits an unceasing flame, which burns day and night." Within a short distance is the great mountain of Takhtalu, the naked summit of which rises, in an insulated peak, 7800 feet above the level of the sea. In the month of August a few streaks of snow were discernable on the peak; but many of the distant mountains of the interior were completely white for nearly a fourth down their sides. It may hence be inferred, that the elevation of this part of Mount Taurus is not less than 10,080 feet, which is equal to that of Mount Etna.

Such a striking feature as this stupendous mountain, in a country inhabited by illiterate and credulous people, cannot fail to have been the subject of numerous tales and traditions. Accordingly, the Captain was informed by the peasants, that there is a perpetual flow of the purest water from the very apex; and that notwithstanding the snow, which was still lingering in the chasms, roses blew there all the year round. He was assured by the Agha of Deliktash that every autumn a midnight groan is heard to issue from the summit of the mountain, louder than the report of any cannon, but unaccompanied by fire or smoke. He professed his ignorance of the cause; but on being pressed for his opinion, gravely replied, that he believed it was an annual summons to the elect, to make the best of their way to Paradise. However amusing this theory may have been, it may possibly be true that such explosions take place. The mountain artillery described by Captains Lewis and Clarke, in their travels in North America, and similar phenomena which are said to have occurred in South America, seem to lend some probability to the account. The natives have also a tradition, that when Moses fled from Egypt, he took up his abode near this mountain, which was therefore named Moossa-Daghy, or the mountain of Moses. Between this story, and the Yanar, as it has been described above, may there not have been some fanciful connection? The site of this volcanic opening is at an inconsiderable distance from the mountain; and the

flame issuing from the thicket which surrounds it, may have led to some confused association with the burning bush on Mount Horeb, recorded in Exodus.

HERCULANEUM.

This city was, together with Pompeii and Stabia, involved in the common ruin occasioned by the dreadful eruption of Vesuvius, in the reign of Titus already described. It was situated on a point of land stretching into the Gulph of *Naples*, about two miles distant from that city, near where the modern towns of Portici and Resini, and the Royal Palace, by which they are separated, now stand. The neck of land on which it was built, and which has since disappeared, formed a small harbour. Hence the appellation of *Herculis Porticum*, the small haven of Hercules, sometimes given to Herculaneum, and thence in all probability, the modern name of Portici. The latter being situated immediately above some of the excavations of Herculaneum, the just fear of endangering its safety, by undermining it, is given as a principal reason why so little progress has been made in the Herculanean researches.

The discovery of Herculaneum is thus explained. At an inconsiderable distance from the Royal Palace of Portici, and close to the sea side, Prince Elbeuf, in the beginning of the last century, inhabited an elegant villa. To obtain a supply of water a well was dug, in the year 1730, through the deep crust of lava on which the mansion itself had been reared. The labourers, after having completely pierced through the lava, which was of considerable depth, came to a stratum of dry mud. This event precisely agrees with the tradition relative to Herculaneum, that it was in the first instance overwhelmed by a stratum of hot mud, which was immediately followed by a wide stream of lava. Whether this mud was thrown up from Vesuvius, or formed by torrents of rain, does not appear to have been decided. Within the stratum the workmen found three female statues, which were sent to Vienna.

It was not until some years after that the researches at Herculaneum were seriously and systematically pursued. By continuing Elbeuf's well, the excavators at once came to the theatre, and from that spot carried on their further sub-

terraneous investigation. The condition of Herculaneum was at that time much more interesting, and more worthy the notice of the traveller, than it is at present. The object of its excavation having unfortunately been confined to the discovery of statues, paintings, and other curiosities, and not carried on with a view to lay open the city, and thus to ascertain the features of its buildings and streets, most of the latter were again filled up with rubbish as soon as they were divested of every thing moveable. The marble even was torn from the walls of the temples. Herculaneum may therefore be said to have been overwhelmed a second time by its modern discoverers; and the appearance it previously presented, can now only be ascertained from the accounts of those who saw it in a more perfect state. Agreeably to them, it must at that time have afforded a most interesting spectacle.

The theatre was one of the most perfect specimens of ancient architecture. It had, from the floor upwards, eighteen rows of seats, and above these, three other rows, which, being covered with a portico, seem to have been intended for the female part of the audience, to screen them from the rays of the sun. It was capable of containing between three and four thousand persons. Nearly the whole of its surface was, as well as the arched walls which led to the seats, cased with marble. The area, or pit, was floored with thick squares of *giallo antico*, a beautiful marble of a yellowish hue. On the top stood a group of four bronze horses, drawing a car, with a charioteer, all of exquisite workmanship. The pedestal of white marble is still to be seen in its place; but the group itself had been crushed and broken in pieces by the immense weight of lava which fell on it. The fragments having been collected, might easily have been brought together again, but having been carelessly thrown into a corner, a part of them were stolen, and another portion fused, and converted into busts of their Neapolitan Majesties. At length, it was resolved to make the best use of what remained, that is, to convert the four horses into one, by taking a fore leg of one of them, a hinder leg of another, the head of a third, &c. and, where the breach was irremediable, to cast a new piece. To this contrivance the bronze horse in the court-yard of the Museum of Portici owes its existence; and,

considering its patchwork origin, still conveys a high idea of the skill of the ancient artist.

In the forum, which was contiguous to the theatre, beside a number of inscriptions, columns, &c. two beautiful equestrian statues of the Balbi family were found. These are of white marble, and are deposited in the hall of the left wing of the Palace at Portici.

Adjoining to the forum stood the temple of Hercules, an elegant rotunda, the interior of which was decorated with a variety of paintings, such as Theseus returning from his Cretan adventure with the Minotaur; Telephus's birth; Chiron the centaur instructing Achilles, &c. These were carefully separated from the walls, and are here deposited in the museum.

The most important discovery, however, was that of a villa, at a small distance from the forum; not only on account of the peculiarity of its plan, but because the greater number of the works of art were dug out of its precinct; and more especially because it contained a library consisting of more than fifteen hundred volumes, which are likewise safely deposited in the museum, and which, were they legible, would form a great classic treasure. These will be considered under the head of PAPYRI.

The villa is conjectured to have belonged to one of the Balbi family. Although elegant, it was small,and consisted of a ground-floor only, like those of Pompeii. Beside a number of small closets round an interior hall, it contained a bathing-room, curiously fitted up with marble and water-pipes, and a chapel of a diminutive size, without any window or aperture for day-light, the walls of which were painted with serpents, and within which a bronze tripod, filled with cinders and ashes, was found standing on the floor.

The apartment which contained the library was fitted up with wooden presses around the walls, about six feet in height: a double row of presses stood insulated in the middle of the room, so as to admit a free passage on every side. The wood of which the presses had been made, was burned to a cinder, and gave way at the first touch; but the volumes, composed of a much more perishable substance, the Egyptian or Syracusan papyrus, were, although completely carbonized through the effect of the heat, still so far pre-

served as to admit of their removal to a similar set of modern presses, provided, however, with glass doors, in the museum.

In the middle of the garden belonging to this villa, was a basin nearly of the size and form of the one in the Green Park, having its edges faced with stone, and the two narrow ends rounded off in a semicircular form. This piece of water was surrounded by beds or *parterres* of various shapes; and the garden was on every side enclosed by a covered walk supported by columns. Of these columns there were sixty-four, ten for each of the shorter, and twenty-two for each of the longer sides of the quadrangle: they were made of brick, neatly stuccoed over, exactly similar to those in the Pompeian barracks. Each pillar supported one end of a wooden beam, the other extremity of which rested on the garden wall, thus forming an arbour, in all probability planted with vines, around the whole garden. Under this covered walk, several semicircular recesses, which appear to have served as bathing-places, were built. The spaces between the pillars were decorated with marble busts and bronze statues, alternately arranged.

This garden was surrounded by a narrow ditch; and another covered walk, of a considerable length, led to a circular balcony, or platform, the ascent to which was by four steps, but which overhung the sea about fifteen feet. The floor of the balcony consisted of the very beautiful tesselated pavement, which now serves as the floor of one of the rooms of the Portici museum. From this charming spot the prospect over the whole Bay of Naples, including the mountains of Sorrento, the Island of Capri, and Mount Posilipo, must have been delightful.

POMPEII.

[*See Plates, No.* 30, 31.]

A GREAT and rich town, which, after lying eighteen centuries in a deep grave is again shone on by the sun, and stands amidst other cities, as much a stranger as any one of its former inhabitants would be among his descendants of the present day—such a town has not its equal in the world.

The distance from Naples to Pompeii is little more than

ten English miles. Near the Torre dell' Annunziata, to the left, and amid hills planted with vineyards, the town itself, which, throwing off its shroud of ashes, came forth from its grave, breaks on the view. The buildings are without roofs, which are supposed to have been destroyed by enemies in an unguarded state, or torn off by a hurricane. The tracks of the wheels which anciently rolled over the pavement are still visible. An elevated path runs by the side of the houses, for foot-passengers; and, to enable them in rainy weather to pass more commodiously to the opposite side, large flat stones, three of which take up the width of the road, were laid at a distance from each other. As the carriages in order to avoid these stones, were obliged to use the intermediate spaces, the tracks of the wheels are there most visible. The whole of the pavement is in good condition: it consists merely of considerable pieces of lava, which, however, are not cut, as at the present, into squares, and may have been on that account the more durable.

The part which was first cleared, is supposed to have been the main street of Pompeii; but this is much to be doubted, as the houses on both sides, with the exception of a few, were evidently the habitations of common citizens, and were small and provided with booths. The street itself likewise is narrow: two carriages only could go abreast; and it is very uncertain whether it ran through the whole of the town; for, from the spot where the moderns, discontinued digging, to that where they recommenced, and where the same street is supposed to have been again found, a wide tract is covered with vineyards, which may very well occupy the places of the most splendid streets and markets, still concealed underneath.

Among the objects which attract particular attention, is a booth in which liquors were sold, and the marble table within which bears the marks of the cups left by the drinkers. Next to this is a house, the threshold of which is inlaid by a salutation of black stone, as a token of hospitality. On entering the habitations, the visitor is struck by the strangeness of their construction. The middle of the house forms a square, something like the cross passages of a cloister, often surrounded by pillars: it is cleanly, and paved with party-coloured mosaic, which has an agreeable

effect. In the middle is a cooling well; and on each side a little chamber, about ten or twelve feet square, but lofty, and painted with a fine red or yellow. The floor is of mosaic; and the door is made generally to serve as a window, there being but one apartment which receives light through a thick blue glass. Many of these rooms are supposed to have been bed-chambers, because there is an elevated broad step, on which the bed may have stood, and because some of the pictures appear most appropriate to a sleeping-room. Others are supposed to have been dressing-rooms, on this account, that on the walls a Venus is described decorated by the Graces, added to which little flasks and boxes of various descriptions have been found in them. The larger of these apartments served for dining-rooms, and in some are to be met with suitable accommodations for cold and hot baths.

The manner in which a whole room was heated, is particularly curious. Against the usual wall a second was erected, standing at a little distance from the first. For this purpose large square tiles were taken, having, like our tiles, a sort of hook, so that they kept the first wall as it were off from them; a hollow space was thus left all around, from the top to the bottom, into which pipes were introduced, that carried the warmth into the chamber, and as it were rendered the whole of the place one stove. The ancients were also attentive to avoid the vapour or smell from their lamps. In some houses there is a niche made in the wall for the lamp, with a little chimney in the form of a funnel through which the smoke ascended. Opposite to the house-door the largest room is placed: it is properly a sort of hall, for it has only three walls, being quite open in the fore part. The side-rooms have no connection with each other, but are divided off like the cells of monks, the door of each leading to a fountain.

Most of the houses consist of one such square surrounded by rooms. In a few some decayed steps seem to have led to an upper story, which is no longer in existence. Some habitations, however, probably belonging to the richer and more fashionable, are far more spacious. In these a first court is often connected with a second, and even with a third, by passages: in other respects their arrangements are pretty similar to those above described.

Many garlands of flowers and vine-branches, and many handsome pictures, are still to be seen on the walls. The guides were formerly permitted to sprinkle these pictures with fresh water, in the presence of travellers, and thus revive their former splendour for a moment: but this is now strictly forbidden; and, indeed, not without reason, since the frequent watering might at length totally rot away the wall.

One of the houses belonged to a statuary, whose workshop is still full of the vestiges of his art. Another appears to have been inhabited by a surgeon, whose profession is equally evident from the instruments discovered in his chamber. A large country-house near the gate undoubtedly belonged to a very wealthy man, and would, in fact, still invite inhabitants within its walls. It is very extensive, stands against a hill, and has many stories. Its finely-decorated rooms are unusually spacious; and it has airy terraces, from which you look down into a pretty garden, that has been now again planted with flowers. In the middle of this garden is a large fish-pond, and near that an ascent from which, on two sides, six pillars descend. The hinder pillars are the highest, the middle somewhat lower, and the front the lowest: they appear, therefore, rather to have propped a sloping roof, than to have been destined for an arbour. A covered passage, resting on pillars, incloses the garden on three sides; it was painted, and probably served in rainy weather as an agreeable walk. Beneath is a fine arched cellar, which receives air and light by several openings from without; consequently its atmosphere is so pure, that in the hottest part of summer it is always refreshing. A number of *amphorae*, or large wine-vessels, are to be seen here, still leaning against the wall, as the butler left them when he carried up the last goblet of wine for his master. Had the inhabitants of Pompeii preserved these vessels with stoppers, wine might still have been found in them; but as it was, the stream of ashes running in, of course forced out the wine. More than twenty human skeletons of fugitives, who thought to save themselves here under ground, but who experienced a tenfold more cruel death than those suffered who were in the open air, were found in this cellar.

The destiny of the Pompeians must have been dreadful.

It was not a stream of fire that encompassed their abodes: they could then have sought refuge in flight. Neither did an earthquake swallow them up; sudden suffocation would then have spared them the pangs of a lingering death.—*A rain of ashes buried them alive* BY DEGREES! We will read the delineation of Pliny:—"A darkness suddenly overspread the country; not like the darkness of a moonless night; but like that of a closed room, in which the light is of a sudden extinguished. Women screamed, children moaned, men cried. Here, children were anxiously calling their parents; and there, parents were seeking their children, or husbands their wives; all recognized each other only by their cries. The former lamented their own fate, and the latter that of those dearest to them. Many wished for death, from the fear of dying. Many called on the gods for assistance: others despaired of the existence of the gods, and thought this the last eternal night of the world. Actual dangers were magnified by unreal terrors. The earth continued to shake, and men, half distracted, to reel about, exaggerating their own fears, and those of others, by terrifying predictions."

Such is the frightful but true picture which Pliny gives us of the horrors of those who were, however, far from the extremity of their misery. But what must have been the feelings of the Pompeians, when the roaring of the mountain, and the quaking of the earth, awaked them from their first sleep? They also attempted to escape the wrath of the gods; and, seizing the most valuable things they could lay their hands upon in the darkness and confusion, to seek their safety in flight. In this street, and in front of the house marked with the friendly salutation on its threshhold, seven skeletons were found: the first carried a lamp, and the rest had still between the bones of their fingers something that they wished to save. On a sudden they were overtaken by the storm which descended from heaven, and buried in the grave thus made for them. Before the above mentioned country-house was still a male skeleton, standing with a dish in his hand; and, as he wore on his finger one of those rings which were allowed to be worn by Roman knights only, he is supposed to have been the master of the house, who had just opened the back-garden gate with the intent of flying,

when the shower overwhelmed him. Several skeletons were found in the very posture in which they had breathed their last, without having been forced by the agonies of death to drop the things they had in their hands. This leads to a conjecture, that the thick mass of ashes must have come down all at once, in such immense quantities as instantly to cover them. It cannot otherwise be imagined how the fugitives could all have been fixed, as it were by a charm, in their position; and in this manner their destiny was the less dreadful, seeing that death suddenly converted them into motionless statues, and thus was stripped of all the horrors with which the fears of the sufferers had clothed him in imagination. But what then must have been the pitiable condition of those who had taken refuge in the buildings and cellars? Buried in the thickest darkness, they were secluded from every thing but lingering torment; and who can paint to himself without shuddering, a slow dissolution approaching, amid all the agonies of body and of mind? The soul recoils from the contemplation of such images.

To proceed now to the public edifices. The temple of Isis is still standing, with its Doric pillars, and its walls painted with emblems of the service of the deity, such as the hippopotamus, cocoa-blossom, ibis, &c. The sacred vessels, lamps, and tables of Isis are still to be seen. From a little chapel withinside, a poisonous vapour is said to have formerly arisen, which the heathen priests may have used for every species of deception. This vapour is said to have increased after the violent eruption of Vesuvius; but has not latterly given out the slightest smell.

A small Grecian temple, of which only two pillars remain, had been probably already destroyed by an earthquake, which, in the reign of Titus, preceded the dreadful irruption of the volcano.—On the opposite side of this temple there is still an edifice, called the quarters of the soldiers, because all sorts of arms, pictures of soldiers, and a skeleton in chains, were found there. By others it has been considered as the forum of Pompeii.

Two theatres, the smaller one particularly, are in an excellent state of preservation. The structure of this one is such as was usually adopted by the ancients, and is well deserving of modern imitation, as it affords the spectators

commodious seats, a free view of the stage, and facility of hearing. Although sufficiently large to contain two thousand persons, the plebeans, standing in a broad gallery at the top, were quite as able to see all that was passing on the stage as the magistrate in his marble balcony. In this gallery the arrangements for spreading the sail-cloth over the spectators are still visible.—The stage itself is very broad, as it has no side walls; and appears less deep than it really is. A wall runs across it, and cuts off just as much room as is necessary for the accommodation of the performers. But this wall has three very broad doors; the middle one is distinguished by its height, and the space behind it is still deeper than in front. If these doors, as may be conjectured, always stood open, the stage was in fact large, and afforded besides the advantage of being able to display a double scenery: if, for example, the scene in front was that of a street, there might have been behind a free prospect into the open field.

The cemetery lies before the gate of the high road. The tomb of the priestess Mammea is very remarkable: it was erected, according to the epitaph, by virtue of a decree of the Decemvirs. In the midst of little boxes of stone, in square piles, and on a sort of altar, the family urns were placed in niches; and withoutside these piles the broken masks are still to be seen. In front of the cemetery, by the road side, is a beautiful seat, forming a semicircle, that will contain twenty or thirty persons. It was probably overshaded by trees eighteen hundred years ago; under which the women of Pompeii sat in the cool evenings, while their children played before them, and viewed the crowds which were passing through the gate.

To the above particulars from the pen of the elegant and lively Kotzebue, the following details, given by a late very accurate traveller, are subjoined.

The entrance into Pompeii is by a quadrangular court, nearly of the size of the railed part of our Leicester Square. This court is surrounded on every side by a colonnade which supports the roof of a gallery; and the latter leads to several small apartments, not unlike the cells of a prison. The columns are of brick, stuccoed over, and painted of a deep red: they are in height from ten to twelve feet; are placed at about a like distance from each other;

and are of the Doric order, fluted two thirds from the top, and well proportioned. After a variety of conjectures relative to the purpose to which this building was applied, it has been ascertained that it was either a barrack for soldiers, (various pieces of armour having been found in some of the cells) or the *Praetorium* of the Governor, where a body of military must have been stationed. Adjacent to it stood the theatres, the forum, and one or two temples, all connected by very neat and well-paved courts.

The smaller of the theatres is to the right, and is called the covered theatre, because it was so constructed, that, by the means of canvas awnings, the spectators were defended from the sun and rain. A door through the wall leads to the different galleries, and to the open space in the centre, resembling the pit of a modern theatre. The interior is beautifully neat; and, with the exception of the spoilation of the marble slabs, removed to the Palace at Portici, with which the whole of the inside, not excepting the seats, had been covered, in excellent preservation. On each side are the seats for the magistrates; the orchestra, as in modern theatres, is in front of the stage; and the latter, with its brick wings, is very shallow. This theatre was calculated to contain about two thousand spectators.

From its level a staircase leads to an eminence on which several public buildings are situated. The most conspicuous of these is a small temple said to have been dedicated to Isis, and having a secret passage, perforated in two places, whence the priests are supposed to have delivered to the deluded multitude the oracles of that deity.

Within a paved court is an altar, of a round shape, on the one side, and on the other side a well. A cistern, with four apertures, was placed at a small distance, to facilitate the procuring of water. In this court, sacrifices and other holy rites are conjectured to have taken place, various utensils for sacrifice, such as lamps, tripods, &c. having been found, when the place was first excavated. One of the tripods is of the most admirable workmanship. On each of the three legs, a beautiful sphinx, with an unusual headdress, is placed, probably in allusion to the hidden meanings of the oracles which were delivered in the above mentioned temple. The hoop in which the basin for the coals was sunk, is elegantly decorated with rams' heads connect-

ed by garlands of flowers; and within the basin, which is of baked earth, the very cinders left from the last sacrifice (nearly two thousand years ago,) are seen as fresh as if they had been the remains of yesterday's fire!

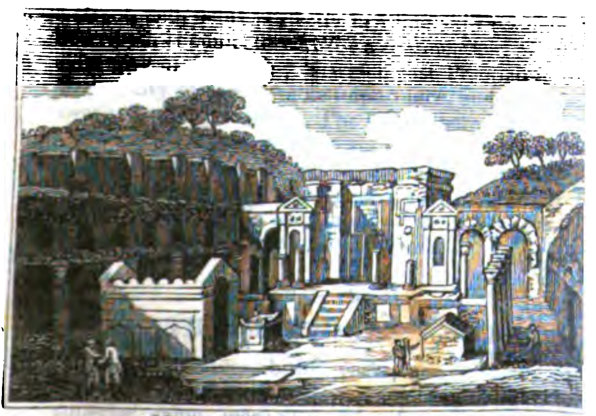
From the above court, you enter on a somewhat larger, with a stone pulpit in the centre, and stone seats near the walls. The spot therefore, was either the auditory of a philosopher, or the place where the public orators pleaded in the presence of the people. Every thing here is in the highest order and preservation.

The great amphitheatre proudly rears its walls over every other edifice on the same elevated spot. It is a stupendous structure, and has twenty-four rows of seats, the circumference of the lowest of which is about 750 feet. It is estimated to have contained about 30,000 spectators. The upper walls are much injured, having partially projected above ground long before the discovery of Pompeii.

A corn-field leads to the excavated upper end of the high street, which consists of a narrow road for carts, with foot-pavements on each side. The middle is paved with large blocks of marble, and the ruts of the wheels proclaim its antiquity, even at the time of its being overwhelmed. The foot-paths are elevated about a foot and a half from the level of the carriage-road. The houses on each side, whether shops or private buildings, have not any claim to external elegance: they consist of a ground-floor only, and, with the exception of the door, have not any opening towards the street. The windows of the private houses look into an inner square court, and are in general very high. The apartments themselves are, with the exception of one in each house, which probably served as a drawing-room, both low and diminutive. In point of decoration they are neat, and, in many instances, elegant: the floors generally consist of figured pavements, either in larger stones of various colours, regularly cut and systematically disposed, or are formed of a beautiful mosaic, with a fanciful border, and an animal or figure in the centre. The geometrical lines and figures in the design of the borders, have an endless variety of the most pleasing shapes, to display the fertile imagination of the artists. Their tesselated pavements alone must convince us that the ancients were well skilled in geometry. The ground is usually white, and the orna-



No. 30.—*Temple of Isis, Pompeii.*



No. 31.—*High Street of Pompeii.*



ments black; but other colours are often employed with increased effect.

The walls of the apartments are equally, if not still more deserving attention. They are painted, either in compartments, exhibiting some mythological or historical event, or simply coloured over with a light ground, adorned with a border and perhaps an elegant little vignette, in the centre or at equal distances. But few of the historical paintings now exist in Pompeii; for wherever a wall was found to contain a tolerable picture, it was removed and deposited in the museum at Portici. To effect this, the greatest care and ingenuity were required, so as to peel off, by the means of sawing pieces of wall, twenty and more square feet in extent, without destroying the picture. This however, was not a modern invention; for, among the excavated remains of Stabiæ, the workmen came to an apartment containing paintings which had been separated by the ancients themselves from a wall, with the obvious intent of their being introduced in another place. This was however, prevented by the ruin of the city; and the paintings, therefore, were found leaning against the wall of the apartment.

Another excavated portion of Pompeii is likewise part of a street, and, being perfectly in a line with the one already described, is conjectured to be a continuation, or rather the extremity of the latter; in which case Pompeii must have been a city of considerable importance, and its main street nearly a mile in length. The houses here, as in the other instance, are distributed into shops and private dwellings, some of the latter of which are distinguished by the remains of former internal elegance, such as tesselated pavements, pointed walls &c; most of them have likewise an interior court, surrounded by apartments.

THE MUSEUM AT PORTICI.

The best statues, busts, vases, and in short, whatever was supposed, from its materials or construction, to have a superior value, were packed in fifty-two chests, and conveyed to Palermo, at the time the court sought refuge in that city, on the French penetrating into the Neapolitan

territory.* What still remains, however, in the Museum, has a high intrinsic value; since who can behold, without the strongest emotions of admiration, the relics of the most transitory things, which for nearly eighteen hundred years, have braved the ravages of time? Here are to be seen bread, corn, dough which was about to be placed in the oven, soap which had been used for washing, figs, and even egg-shells perfectly white, and in as good a state as if the cook had broken them an hour before. Here a kitchen presents itself provided with every thing requisite: trivets and pots stand on the hearth; stew-pans hang on the wall; skimmers and tongs are placed in the corner; and a metal mortar rests on the shaft of a pillar. Weights, hammers, scythes, and other utensils of husbandry, are here blended with helms and arms. Sacrificing bowls and knives; a number of well-shaped glasses; large and small glass bottles; lamps; vases; decorations for furniture; a piece of cloth; nets; and even shoe soles; all sorts of female ornaments,—necklaces, rings, and ear-rings; a wooden chess-board, reduced, indeed, to a cinder: all these things are more or less injured by the fire; but still are distinguishable at first sight.

Every apartment of the museum is laid with the most charming antique floors, which are partly mosaic, from Pompeii, and partly marble, from Herculaneum. Statues, vases, busts, chandeliers, altars, tables of marble and bronze, are all in as good a state as if they had just come from the hands of the artist. The coins which have been collected are very numerous, and fill several cases. Medallions of marble, containing on each side a bas-relief, are suspended by fine chains from the ceiling of one of the apartments, and are within the reach of the hand, so as to be conveniently turned and examined.

Most of the pictures found at Herculaneum, Pompeii, and Stabiæ, and now deposited in the museum, have been sawed from the walls of the edifices they adorned. These unique relics of ancient art form an extensive gallery of genuine antique pictures, the only one in the world, and may on that account alone, be considered as an inappreciable treasure. They are placed in a range of apartments on the ground floor, and are suspended against the walls in plain frames. Their size varies from a foot square, to

whole-length groupes, nearly as large as life. Beside the injury they have sustained by having been exposed to the heat of burning cinders, they have been impaired by the modern varnish which was intended to protect them: it would, therefore, not be right to subject their colouring to the rigid rules of art; but the grouping of the Minotaur, of the Telephus, of the sitting Orestes, and of the Bacchus and Ariadne, is admirable. In their paintings, as well as in their sculptures, the ancients were influenced by that love of simplicity which distinguishes their works from those of the moderns, and the result is, that in them the chief merits of composition are combined,—unity of subject, and unity of interest. When, again, it is considered, that the paintings collected in the museum at Portici were taken from the provincial towns, it must be inferred, that those which were admitted in the chief seats of art corresponded in excellence with the Lacoon and the Apollo.—Such was the judgement of the ancients themselves, and their taste is not to be disputed.

The museum at Portici excels all others in ancient bronze,—a substance which, although dearer, more difficult to be wrought, more inviting to the rude grasp of avarice, and less beautiful than marble, forms the greater proportion of the statues. The larger of them had been originally composed of pieces connected by dove-tail joints; and these promiscuous fragments have been recompiled into new figures, as in the instance of the single horse made from four, in the centre of the court-yard of the museum. Those fragments which had escaped fusion, were rent, inflated, or bruised, by the burning lava. In addition to these misfortunes, they have been made up unhappily; for the eye of an artist can sometimes detect two styles of art, evidently different, the large and the exquisite, soldered together in the same statue. The figures most admired are, the drunken Faun; the sleeping Faun; the sitting Mercury; the Amazon adjusting her robe; and an Augustus and a Claudius, both of heroic size.

The most remarkable objects in the museum at Portici, are the manuscripts, found in two chambers of a house at Herculaneum. Although they have been so frequently described, they must be seen, to furnish a correct idea of them. Before they are devolved, they resemble sticks of

charcoal, or cudgels reduced to the state of a cinder, and partly petrified. They are black and chesnut-brown: and are unfortunately so decayed, that under each of them, as they lie in glass cases, a quantity of dust and detached fragments may be perceived. Their characters are legible in a certain light only, by a gloss and relief which distinguishes the ink, or rather black paint, from the tinder. Cut, crushed, crumbled on the edge, and caked by the sap remaining, in the leaves of the papyrus, they require in the operator great sagacity to meet the variety of injuries they have received; since, in gluing rashly the more delicate parts, he might reach the heart of a volume, while working at the outside. At first, it appeared almost impracticable ever to decypher a syllable of them; but to the industry and talents of man nothing is impossible, and his curiosity impels him to the most ingenious inventions.

*** As the preservation of the subterraneous cities of Herculaneum and Pompeii was owing to a natural cause, that of the dreadful eruption of Vesuvius in the seventy-ninth year of the Christian era, the details relative to these cities, and the interesting results to which their discovery has led, have been introduced among the class of natural wonders now under consideration.

EARTHQUAKES.

"*He looketh on the earth, and it trembleth: he toucheth the hills, and they smoke.*"

Towers, temples, palaces,
Flung from their deep foundations, roof on roof
Crushed horrible, and pile on pile o'erturned,
Fall total.
MALLET.

The globe around earth's hollow surface shakes,
And is the ceiling of her sleeping sons.
O'er devastation we blind revels keep;
Whose buried towns support the dancer's heel.
YOUNG.

THAT fires to a very great extent, and produced by various causes, exist at different depths beneath the surface of the earth, must be evident to those who have attentively perused what has been given under the head of Volcanoes;

and recent experiments have shown, that, where the substances in which such fires occur, lie at a considerable depth, and are surmounted by a very deep and heavy superincumbent pressure, more especially when they contain large portions of elastic gases, the effect of such fires will be much greater, and more diversified, than where these circumstances are absent.

Among the most powerful and extraordinary of these effects earthquakes are to be reckoned. They are unquestionably the most dreadful of the phenomena of nature, are not confined to those countries which from the influence of climate, their vicinity to volcanic mountains, or any other similar cause, have been considered as more particularly subject to them, their effects having oft been felt in the British isles, although not in so extensive and calamitous a degree. Their shocks and the eruptions of volcanoes, have been considered as modifications of the effects of one common cause; and where the agitation produced by an earthquake extends farther than there is reason to suspect a subterraneous commotion, it is probably propagated through the earth nearly in the same manner as a noise is conveyed through the air. The different hypotheses which have been imagined on this subject may be reduced to the following:

Some naturalists have ascribed earthquakes to water, others to fire, and others, again, to air; each of these powerful agents being supposed to operate in the bowels of the earth, which they assert to abound every where with huge subterraneous caverns, veins, and canals, some filled with water, others with gaseous exhalations, and others replete with various substances, such as nitre, sulphur, bitumen, and vitriol. Each of these opinions has its advocates, who have written copiously on the subject.

In a paper published in the Philosophical Transactions, Dr. Lister ascribes earthquakes, as well as thunder and lightning, to the inflammable breath of the pyrites, a substantial sulphur, capable of spontaneous combustion; in a word, as Pliny had observed before him, he supposes an earthquake to be nothing more than subterraneous thunder. Dr. Woodward thinks, that the subterraneous fire which continually raises the water from the abyss, or great reservoir, in the centre of the earth, for the supply

of dew, rain, springs, and rivers, being diverted from its ordinary course by some accidental obstruction in the pores through which it used to ascend to the surface, becomes, by such means, preternaturally assembled in a greater quantity than usual, in one place, and thus causes a rarefaction and intumescence of the water of the abyss, throwing it into greater commotions, and at the same time making the like effort on the earth, which, being expanded on the surface of the abyss, occasions an earthquake. Mr. Mitchell supposes these phenomena to be occasioned by subterraneous fires, which if a large quantity of water be let loose on them suddenly, may produce a vapour, the quantity and elastic force of which may fully suffice for the purpose. Again, M. Amontus, a member of the French Academy of Sciences, endeavours to prove, that, on the principle of experiments made on the weight and spring of the air, a moderate degree of heat may bring that element into a state capable of causing earthquakes.

Modern electrical discoveries have thrown much light on this subject. Dr. Stukely strenuously denies that earthquakes are to be ascribed to subterraneous winds, fires, or vapours; and thinks that there is not any evidence of the cavernous structure of the earth, which such a hypothesis requires. Subterraneous vapours he thinks, are altogether inadequate to the effects produced by earthquakes, more particularly in cases where the shock is of considerable extent: for a subterraneous power, capable of moving a surface of earth only thirty miles in diameter, must be lodged at least fifteen or twenty miles below the surface, and move an inverted cone of solid earth, whose basis is thirty miles in diameter, and axis fifteen or twenty miles, which he thinks absolutely impossible. How much more inconceivable is it, then, that any such power could have produced the earthquake of 1755, which was felt in various parts of Europe and Africa, and in the Atlantic ocean; or that which in Asia Minor, in the seventeenth year of the Christian era, destroyed thirteen great cities in one night, and shook a mass of earth three hundred miles in diameter. To effect this, the moving power, supposing it to have been internal fire or vapour, must have been lodged two hundred miles beneath the surface of the earth! Besides, in earthquakes, the effect is instantaneous; whereas

the operation of elastic vapour, and its discharge, must be gradual, and require a long space of time; and if these be owing to explosions, they must alter the surface of the country where they happen, destroy the fountains and springs, and change the course of its rivers,—results which are contradicted by history and observation.

To these and other considerations the Doctor adds, that the strokes which ships receive during an earthquake, must be occasioned by something which can communicate motion with much greater velocity than any heaving of the earth under the sea, caused by the elasticity of generated vapours, which would merely produce a gradual swell, and not such an impulsion of the water as resembles a violent blow on the bottom of a ship, or its striking on a rock. Hence he deems the common hypothesis insufficient, and adduces several reasons to show that earthquakes are in reality electric shocks. To confirm this opinion, he notices, among other phenomena, either preceding or attending earthquakes, that the weather is usually dry and warm for some time before they happen, and that the surface of the ground is thus previously prepared for that kind of electrical vibration in which they consist; while, at the same time, in several places where they have occurred, the internal parts, at a small depth beneath the surface, were moist and boggy. Hence he infers, that they reach very little beneath the surface. That the southern regions are more subject to earthquakes than the northern, he thinks is owing to the greater warmth and dryness of the earth and air, which are qualities so necessary to electricity. It may here be noticed, that, before the earthquakes of London, in 1749, all vegetation was remarkably forward; and it is well known, that electricity quickens vegetation. The frequent and singular appearance of boreal and austral *aurorae*, and the variety of meteors by which earthquakes are preceded, indicate an electrical state of the atmosphere; and the Doctor apprehends that, in this state of the earth and air, nothing more is necessary to produce these phenomena, than the approach of a non-electric cloud, and the discharge of its contents, on any part of the earth, when in a highly electrified state. In the same way as the discharge from an excited tube occasions a commotion in the human body, so the shock pro-

duced by the discharge between the cloud and many miles in compass of solid earth, must be an earthquake, and the snap from the contact the noise attending it.

The theory of M. de St. Lazare differs from the above hypothesis, as to the electrical cause. It ascribes the production of earthquakes to the interruption of the equilibrium between the electrical matter diffused in the atmosphere, and that which belongs to the mass of our globe, and pervades its bowels. If the electrical fluid should be superabundant, as may happen from a variety of causes, its current, by the laws of motion peculiar to fluids, is carried towards those places where it is in a similar quantity; and thus it will sometimes pass from the internal parts of the globe into the atmosphere. This happening if the equilibrium be re-established without difficulty, the current merely produces the effect of what M. de St. Lazare calls ascending thunder; but if this re-establishment be opposed by considerable and multiplied obstacles, the consequence is then an earthquake, the violence and extent of which are in exact proportion to the degree of interruption of the equilibrium, the depth of the electric matter, and the obstacles which are to be surmounted. If the electric furnace be sufficiently large and deep to give rise to the formation of a conduit or issue, the production of a volcano will follow, its successive eruptions being, according to him, nothing more in reality than electric repulsions of the substances contained in the bowels of the earth. From this reasoning he endeavours to deduce the practicability of forming a counter-earthquake, and a counter-volcano, by means of certain electrical conductors, which he describes, so as to prevent these convulsions in the bowels of the earth.

The opinion of Signior Beccaria is nearly similar; and from his hypothesis and that of Dr. Stukely, the celebrated Priestley has endeavoured to form one still more general and more feasible. He supposes the electric fluid to be in some mode or other accumulated on one part of the surface of the earth, and, on account of the dryness of the season, not to diffuse itself readily: it may thus, as Beccaria conjectures, force its way into the higher regions of the air, forming clouds out of the vapours which float in the atmosphere, and may occasion a sudden shower, which

may further promote its progress. The whole surface being thus unloaded, will, like any other conducting substance, receive a concussion, either on parting with, or on receiving any quantity of the electric fluid. The rushing noise will likewise sweep over the whole extent of the country; and, on this supposition also, the fluid, in its discharge from the surface of the earth, will naturally follow the course of the rivers, and will take the advantage of any eminences to facilitate its ascent into the higher regions of the air.

Such are the arguments in favour of the electrical hypothesis; but, since it has been supported with so much ability, an ingenious writer, Whitehurst, in his Inquiry into the original State and Formation of the Earth, contends, that subterraneous fire, and the steam generated from it, are the true and real causes of earthquakes. When, he observes, it is considered that the expansive force of steam, is to that of gunpowder as twenty-eight to one, it may be conceded that this expansive force, and the elasticity of steam, are in every way capable of producing the stupendous effects attributed to these phenomena.

Among the most striking phenomena of earthquakes, which present a fearful assemblage of the combined effects of air, earth, fire, and water, in a state of unrestrained contention, may be noticed the following:—Before the percussion a rumbling sound is heard, proceeding either from the air, or from fire, or, perhaps, from both in conjunction, forcing their way through the chasms of the earth, and endeavouring to liberate themselves: this, as has been seen, likewise happens in volcanic eruptions. Secondly, a violent agitation or heaving of the sea, sometimes preceding, and sometimes following the shock: this is also a volcanic effect. Thirdly, a spouting up of the waters to a great height—a phenomenon which is common to earthquakes and volcanoes, and which cannot be readily accounted for. Fourthly, a rocking of the earth, and, occasionally, what may be termed a perpendicular rebounding: this diversity has been supposed by some naturalists to arise chiefly from the situation of the place, relatively to the subterraneous fire, which, when immediately beneath, causes the earth to rise, and when at a distance, to rock. Fifthly, earthquakes are sometimes observed to travel on-

ward, so as to be felt in different countries at different hours of the same day. This may be accounted for by the violent shock given to the earth at one place, and communicated progressively by an undulatory motion, successively affecting different regions as it passes along, in the same way as the blow given by a stone thrown into a lake, is not perceived at the shore until some time after the first concussion. Sixthly, the shock is sometimes instantaneous, like the explosion of gunpowder, and sometimes tremulous, lasting for several minutes. The nearer to the observer the place where the shock is first given, the more instantaneous and simple it appears; while, at a greater distance, the earth seems to redouble the first blow, with a sort of vibratory continuation. Lastly, as the waters have in general so great a share in the production of earthquakes, it is not surprising that they should generally follow the breaches made by the force of fire, and appear in the great chasms opened by the earth.

EARTHQUAKES OF REMOTE TIMES.

The most remarkable earthquakes of ancient times are described by Pliny in his Natural History. Among the most extensive and destructive of these was the one already noticed, by which thirteen cities in Asia Minor were swallowed up in one night. Another which succeeded, shook the greater part of Italy. But the most extraordinary one, described by him, happened during the consulate of Lucius Marcus and Sextus Julius, in the Roman province of Mutina. He relates, that two mountains felt so tremendous a shock, that they seemed to approach and retire with a most dreadful noise. They at the same time, and in the middle of the day, cast forth fire and smoke, to the dismay of the astonished spectator. By this shock several towns were destroyed, and all the animals in their vicinity killed. During the reign of Trajan, the city of Antioch was, together with a great part of the adjacent country, destroyed by an earthquake; and about three hundred years after, during the reign of Justinian, it was again destroyed, with the loss of forty thousand of its inhabitants. Lastly, after an interval of sixty years, that

ill-fated city was a third time overwhelmed, with a loss of sixty thousand souls.

The earthquake which happened at Rhodes, upwards of two hundred years before the Christian era, threw down the famous Colossus, together with the arsenal, and a great part of the walls of the city. In the year 1182, the greater part of the cities of Syria, and of the kingdom of Jerusalem, were destroyed by a similar catastrophe; and in 1594, the Italian writers describe an earthquake at Puteoli, which occasioned the sea to retire two hundred yards from its former bed.

EARTHQUAKE IN CALABRIA.

[*See Plate, No.* 32.]

The dreadful earthquake which happened in Calabria, in 1638, is described by the Father Kircher, who was at that time on his way to Sicily to visit Mount Etna. In approaching the Gulf of Charybdis, it appeared to whirl round in such a manner as to form a vast hollow, verging to a point in the centre. On looking towards Etna, it was seen to emit large volumes of smoke, of a mountainous size, which entirely covered the whole island, and obscured from *his* view the very shores. This, together with the dreadful noise, and the sulphureous stench, which was strongly perceptible, filled him with apprehensions that a still more dreadful calamity was impending. The sea was agitated, covered with bubbles, and had altogether a very unusual appearance. The Father's surprise was still increased by the serenity of the weather, there not being a breath of air, nor a cloud, which might be supposed to put all *nature thus* in motion. He therefore warned his companions that an earthquake was approaching, and landed with all possible diligence at Tropæa, in Calabria.

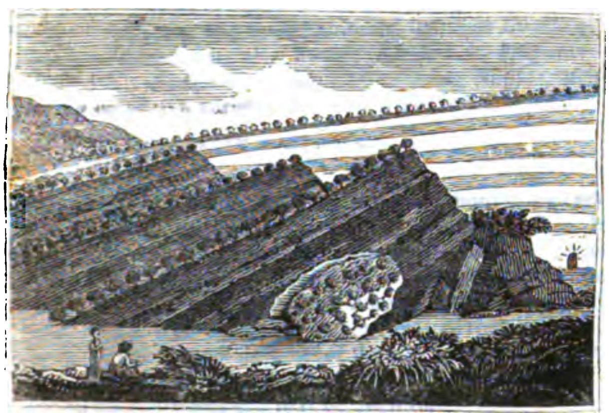
He had scarcely reached the Jesuits' College, when his ears were stunned with a horrid sound, resembling that of an infinite number of chariots driven fiercely forward, the wheels rattling, and the thongs cracking. The tract on which he stood seemed to vibrate, as if he had been in the scale of a balance which still continued to waver. The motion soon becoming more violent, he was thrown prostrate on the ground. The universal ruin around him now redoubled his amazement: the crash of falling houses,

the tottering of towers, and the groans of the dying, all contributed to excite emotions of terror and despair. Danger threatened him wherever he should flee; but, having remained unhurt amid the general concussion, he resolved to venture for safety, and reached the shore, almost terrified out of his reason. Here he found his companions, whose terrors were still greater than his own.

He landed on the following day at Rochetta, where the earth still continued to be violently agitated. He had, however, scarcely reached the inn at which he intended to lodge, when he was once more obliged to return to the boat: in about half an hour the greater part of the town, including the inn, was overwhelmed, and the inhabitants buried beneath its ruins.

Not finding any safety on land, and exposed, by the smallness of the boat to a very hazardous passage by sea, he at length landed at Lopizium, a castle midway between Tropæa and Euphæmia, the city to which he was bound. Here, wherever he turned his eyes, nothing but scenes of ruin and horror appeared: towns and castles were levelled to the ground; while Stromboli, although sixty miles distant, was seen to vomit flames in an unusual manner, and with a noise which he could distinctly hear. From remote objects his attention was soon diverted to contiguous danger: the rumbling sound of an approaching earthquake, with which he was by this time well acquainted, alarmed him for the consequences. Every instant it grew louder, as if approaching; and the spot on which he stood shook so dreadfully, that being unable to stand, himself and his companions caught hold of the shrubs which grew nearest to them, and in that manner supported themselves.

This violent paroxysm having ceased, he now thought of prosecuting his voyage to Euphæmia, which lay within a short distance. Turning his eyes towards that city, he could merely perceive a terrific dark cloud, which seemed to rest on the place. He was the more surprised at this, as the weather was remarkably serene. Waiting, therefore, until this cloud had passed away, he turned to look for the city; but, alas! it was totally sunk, and in its place a dismal and putrid lake was to be seen. All was a melancholy solitude—a scene of hideous desolation. Such was the fate of the city of Euphæmia; and such the



No. 32.—Earthquake in Calabria.



No. 33.—Earthquake in Lisbon.

that the most resolute person durst not stay a moment to extricate the friend he loved most affectionately, by the removal of the stones beneath the weight of which he was crushed. Self-preservation alone was consulted; and the most probable security was sought, by getting into open places, and into the middle of the streets. Those who were in the upper stories of the houses, were in general more fortunate than those who attempted to escape by the doors, many of the latter being buried beneath the ruins, with the greater part of the foot passengers. Those who were in carriages escaped the best, although the drivers and cattle suffered severely. The number, however, of those who perished in the streets, and in the houses, was greatly inferior to that of those who were buried beneath the ruins of the churches; for, as it was a day of solemn festival, these were crowded for the celebration of the mass. They were more numerous than the churches of London and Westminster taken collectively; and the lofty steeples in most instances, fell with the roof, insomuch that few escaped.

The first shock as has been noticed, was extremely short, but was quickly succeeded by two others; and the whole, generally described as a single shock, lasted from five to seven minutes. About two hours after, fires broke out in three different parts of the city; and this new calamity prevented the digging out of the immense riches concealed beneath the ruins. From a perfect calm, a fresh gale immediately after sprang up, and occasioned the fire to rage with such fury, that in the space of three days the city was nearly reduced to ashes. Every element seemed to conspire towards its destruction; for, soon after the shock, which happened near high water, the tide rose in an instant forty feet, and at the castle of Belem, which defends the entrance of the harbour, fifty feet higher than had ever been known. Had it not subsided as suddenly, the whole city would have been submerged. A large new quay sunk to an unfathomable depth, with several hundreds of persons, not one of the bodies of whom was afterwards found. Before the sea thus came rolling in like a mountain, the bar was seen dry from the shore.

The terrors of the surviving inhabitants were great and multiplied. Amid the general confusion, and through a

scarcity of hands, the dead bodies could not be buried, and it was dreaded that a pestilence would ensue; but from this apprehension they were relieved by the fire, by which these bodies were for the greater part consumed. The fears of a famine were more substantial; since, during the three days succeeding the earthquake, an ounce of bread was literally worth a pound of gold. Several of the corn-magazines having been, however, fortunately saved from the fire, a scanty supply of bread was afterwards procured. Next came the dread of the pillage and murder of those who had saved any of their effects; and this happened in several instances, until examples were made of the delinquents.

The great shock was succeeded about noon by another, when the walls of several houses which were still standing, were seen to open, from the top to the bottom, more than a fourth of a yard, and afterwards to close again so exactly as not to leave any signs of injury. Between the first and the eighth of November twenty-two shocks were reckoned.

A boat on the river, about a mile distant from Lisbon, was heard by the passengers to make a noise as if it had run aground, although then in deep water: they at the same time saw the houses falling on both sides of the river, in front of which, on the Lisbon side, the greater part of a convent fell, burying many of its inmates beneath the ruins, while others were precipitated into the river. The water was covered with dust, blown by a strong northerly wind; and the sun entirely obscured. On landing, they were driven by the overflowing of the waters to the high grounds, whence they perceived the sea, at a mile's distance, rushing in like a torrent, although against wind and tide. The bed of the Tagus was in many places raised to its surface; while ships were driven from their anchors, and jostled together with such violence, that their crews did not know whether they were afloat or aground. The master of a ship, who had great difficulty in reaching the port of Lisbon, reported that, being fifty leagues at sea, the shock was there so violent as to damage the deck of the vessel. He fancied he had mistaken his reckoning, and struck on a rock.

The following observations, relative to this fatal earthquake, were made at Colares, about twenty miles from

Lisbon, and within two miles of the sea. On the last day of October, the weather was clear, and remarkably warm for the season. About four o'clock in the afternoon a fog arose, proceeding from the sea, and covering the vallies, which was very unusual at that season of the year. The wind shifted soon after to the east, and the fog returned to the sea, collecting itself, and becoming exceedingly thick. As the fog retired, the sea rose with a prodigious roaring. On the first of November, the day broke with a serene sky, the wind continuing at east; but about nine o'clock the sun began to be obscured; and about half an hour after a rumbling noise was heard, resembling that of chariots, and increasing to such a degree, that at length it became equal to the explosions of the largest artillery. Immediately a shock of an earthquake was felt; and this was succeeded by a second and a third, at the same time that several light flames of fire, resembling the kindling of charcoal, issued from the mountains. During these three shocks, the walls of the buildings moved from east to west. In another spot, where the sea-coast could be descried, a great quantity of smoke, very thick, but somewhat pale, issued from the hill named the Fojo. This increased with the fourth shock, at noon, and afterwards continued to issue in a greater or less degree. Immediately as the subterraneous rumblings were heard, the smoke was observed to burst forth at the Fojo; and its volume was constantly proportioned to the noise. On visiting the spot whence it was seen to arise, not any sign of fire could be perceived near it.

After the earthquake, several fountains were dried up; while others, after undergoing great changes, returned to their pristine state. In places where there had not been any water, springs burst forth, and continued to flow; several of these spouted to the height of nearly twenty feet, and threw up sand of various colours. On the hills rocks were split, and the earth rent; while towards the coast several large portions of rock were thrown from the eminences into the sea.

At Oporto, near the mouth of the river Duero, the earthquake was felt at the same time as at Lisbon. The sky was very serene, when a dreadful hollow noise, resembling thunder, or the rattling of coaches at a dis-

tance, was heard, and almost at the same instant the earth began to quake. In the space of two minutes, the river rose and fell five or six feet, and continued to do so for four hours. At the commencement it ran with so much violence as to break a ship's hawser. In some parts the river opened, and seemed to discharge vast quantities of air. The agitation of the sea was so great, about a league beyond the bar, that air was supposed to have been discharged there also.

During the first shock, which was very terrible, the houses in the city were rocked, as if in a convulsion, and every thing within shook and rattled to such a degree, that the affrighted inhabitants ran into the streets, where the earth was evidently seen to heave up. At six o'clock in the evening another violent shock was felt. The only damage done was the overturning of a few pedestals from the tops of the churches, and the splitting of the walls of the decayed houses.

Saint Ubes, a sea-port town about twenty miles south of Lisbon, was entirely swallowed up by the repeated shocks, and by the vast surf of the sea. Huge pieces of rock were detached at the same time from the promontory at the west end of the town, which consists of a chain of mountains containing fine jasper of different colours.

At Cadiz, a sea-port of Spain, according to the report of Don Antonia d'Ulloa, the earthquake commenced at three minutes after nine in the morning of the first of November, and continued five minutes, the weather being at the time remarkably fine. It was, he observes, not inferior in violence to that which swallowed up Lima and Callao, in Peru, towards the end of October, 1746, and was nearly of twice the duration, the latter having been felt for three minutes only. That every thing here was not destroyed, appears to have been owing to the great solidity of the buildings. The water of the cisterns, under ground, was washed backward and forward, and was covered with a great froth. The inhabitants, who had quitted the houses and churches, seeking safety in the open air, had scarcely recovered from their first terror, when they were plunged into a new alarm. At ten minutes after eleven o'clock, a wave was seen coming from the sea at the distance of eight miles, and at least sixty feet higher

than usual. It dashed against the west part of the city, which is very rocky. Although its force was much broken by these rocks, it at length reached the walls, and beat in the breast-work, which was sixty feet above the ordinary level of the water, removing pieces of the fabric, of the weight of eight or ten tons, to the distance of forty or fifty yards. At half past eleven came a second wave; and this was followed by four others of equal magnitude. Others, but smaller, and gradually lessening, continued at uncertain intervals until the evening. A considerable part of the rampart was thrown down, and carried by the torrent above fifty paces. Several persons perished on the causeway leading to the Isle of Leon. The accounts brought to Cadiz reported that SEVILLE had been much damaged, and that a similar fate had attended St. LUCAR and CHERES. CONEL was said to have been destroyed; and, indeed, with the exception of the provinces of Catalonia, Aragon, and Valencia, the effects of this earthquake were felt throughout Spain.

At MADRID the shock was very sensibly felt soon after ten in the morning, and lasted five or six minutes. At first the inhabitants fancied they were seized with a swimming in the head; and, afterwards, that the houses were falling. In the churches the sensations were the same, and the terror so great, that the people trod each other under foot in getting out. Those who were within the towers were still more affrighted, fancying every instant while the shock lasted, that they were falling to the ground. It was not sensible to those who were in carriages, and very little so to foot passengers.

At GIBRALTAR it was felt about the same time as at Madrid, and began with a tremulous motion of the earth, which lasted about half a minute. A violent shock succeeded; and this again was followed by a second tremulous motion, of the duration of five or six seconds. Another shock, not so violent as the first, subsided gradually; and the whole lasted about two minutes. Several of the guns on the batteries were seen to rise, and others to sink, while the earth had an undulating motion. The greater part of the garrison and inhabitants were seized with giddiness and sickness: several fell prostrate; others were stupified; and many who were walking or riding, became sick, with-

out being sensible of any motion of the earth. Every
teen minutes the sea rose six feet; and then fell so low,
the boats and small vessels near the shore were left agro
as were also numbers of small fish. The flux and re
lasted till next morning, having decreased gradually f
two in the afternoon.

In AFRICA this earthquake was felt almost as seve
as it had been in Europe. A great part of the cit
ALGIERS was destroyed. At ARZILLA, a town belon
to the kingdom of Fez, about ten in the morning, the
suddenly rose with such impetuosity, that it lifted
vessel in the bay, and impelled it with such force or
land, that it was shattered in pieces; and a boat was fo
two musket-shots within land from the sea. At FEZ
MEQUINEZ, great numbers of houses fell down, an
multitude of people were buried beneath the ruins.
MOROCCO, similar accidents occurred; and at SALLE
much damage was done. At TANGIER the earthqu
began at ten in the morning, and lasted ten or tw
minutes. At TETUAN it commenced at the same t
but was of less duration; three of the shocks were s
tremely violent, that it was feared the whole city wou
destroyed.

In the city of FUNCHAL, in the island of Madeir
shock of this earthquake was felt at thirty-eight min
past nine in the morning. It was preceded by a rumb
noise in the air, like that of empty carriages passing ha
over a stone pavement. The observer felt the floor ben
him immediately to be agitated by a tremulous motio
brating very quickly. The shock continued more th
minute; during which space the vibrations, although
tinual, were twice very sensibly weakened and increas
force. The increase after the first remission of the s
was the most intense. During the whole of its con
ance it was accompanied by a noise in the air; and
lasted some seconds after the motion of the earth
ceased, dying away like a peal of distant thunder r
through the air. At three quarters past eleven, the
which was quite calm, suddenly retired several p
when rising with a great swell, and without any noi
as suddenly advanced, overflowed the shore, and en
the city. It rose fifteen feet perpendicular above

water mark, although the tide, which there flows seven feet, was at half-ebb. The water immediately receded; and after having fluctuated four or five times between high and low water mark, it subsided, and the sea remained calm as before. In the northern part of the island the inundation was more violent, the sea there retiring above a hundred paces at first, and suddenly returning, overflowed the shore, forcing open doors, breaking down the walls of several magazines and storehouses, and leaving great quantities of fish ashore, and in the streets of the village of Machico. All this was the effect of one rising of the sea, for it never afterwards flowed high enough to reach the high-water mark. It continued, however, to fluctuate here much longer before it subsided than at Funchal; and in some places farther to the westward, it was hardly, if at all, perceptible.

These were the phenomena with which this remarkable earthquake was attended in those places where it was most violent. The effects of it, however, reached to an immense distance; and were perceived chiefly by the agitations of the waters, or some slight motion of the earth. Its utmost boundaries to the south are unknown; the barbarity of the African nations rendering it impossible to procure any intelligence from them, except where the effects were dreadful. On the north, however, we are assured, that it reached as far as Norway and Sweden. In the former kingdom, the waters of several rivers and lakes were violently agitated. In the latter, shocks were felt in several provinces, and all the rivers and lakes were strongly agitated, especially in Dalecarlia. The river Dala suddenly overflowed its banks, and as suddenly retired. At the same time, a lake at the distance of a league from it, and with which it had no manner of communication, bubbled up with great violence. At Fahlun, a town in Dalecarlia, several strong shocks were felt.

In many places of Germany the effects of this earthquake were very perceptible; but in Holland, the agitations were still more remarkable. At Alphen on the Rhine, between Leyden and Woerden, in the afternoon of the first of November, the waters were agitated to such a violent degree, that buoys were broken from their chains, large vessels snapped their cables, small ones were thrown

out of the water upon the land, and others lying on land were set afloat. At AMSTERDAM, about eleven in the forenoon, the air being perfectly calm, the waters were suddenly agitated in their canals, so that several boats broke loose; chandeliers were observed to vibrate in the churches; but no motion of the earth, or concussion of any building was observed. At HAERLEM, in the forenoon, for nearly four minutes, not only the water in the rivers, canals, &c. but also all kinds of fluids in smaller quantities, as in coolers, tubs, backs, &c. were surprisingly agitated, and dashed over the sides, though no motion was perceptible in the vessels themselves. In these small quantities also the fluid apparently ascended prior to its turbulent motion; and in many places, even the rivers and canals rose one foot perpendicular.

The agitation of the waters was also perceived in various parts of Great Britain and Ireland. At BARLBOROUGH, in Derbyshire, between eleven and twelve in the forenoon, in a boat-house on the west side of a large body of water, called Pibley Dam, supposed to cover at least thirty acres of land, was heard a surprising and terrible noise; a large swell of water came in a current from the south, and rose two feet on the sloped dam-head at the north end of the water. It then subsided, but returned again immediately, though with less violence. The water was thus agitated for three quarters of an hour; but the current grew every time weaker and weaker, till at last it entirely ceased.

At BUSBRIDGE, in Surrey, at half an hour after ten in the morning, the weather being remarkably still, without the least wind, in a canal nearly seven hundred feet long, and fifty-eight in breadth, with a small spring constantly running through it, a very unusual noise was heard at the east end, and the water there observed to be in great agitation. It raised itself in a heap or ridge in the middle; and this heap extended lengthwise about thirty yards, rising between two and three feet above the usual level. After this, the ridge heeled or vibrated towards the north side of the canal, with great force, and flowed above eight feet over the grass walk on that side. On its return back into the canal, it again ridged in the middle, and then heeled with yet greater force to the south side, and flowed over

its grass walk. During this latter motion, the bottom on the northside was left dry for several feet. This appearance lasted for about a quarter of an hour, after which the water became smooth and quiet as before. During the whole time, the sand at the bottom was thrown up and mixed with the water; and there was a continual noise like that of water turning a mill. At COBHAM, in Surrey, DUNSTALL, in Suffolk, EARSY COURT, in Berkshire, EATONBRIDGE, Kent, and many other places, the waters were variously agitated.

At EYAM-BRIDGE, in Derbyshire Peak, the overseer of the lead-mines, sitting in his writing-room, about eleven o'clock, felt a sudden shock, which very sensibly raised him up in his chair, and caused several pieces of plaster to drop from the sides of the room. The roof was so violently shaken, that he imagined the engine-shaft had been falling in. Upon this he immediately ran to see what was the matter, but found every thing in perfect safety. At this time two miners were employed in carting, or drawing along the drifts of the mines, the ore and other materials to be raised up at the shafts. The drift in which they were working was about a hundred and twenty yards deep, and the space from one end to the other fifty yards or upwards. The miner at the end of the drift had just loaded his cart, and was drawing it along; but he was suddenly surprised by a shock, which so terrified him, that he immediately quitted his employment, and ran to the west end of the drift to his partner, who was no less terrified than himself. They durst not attempt to climb the shaft, lest that should be running in upon them: but while they were consulting what means they should take for their safety, they were surprised by a second shock, more violent than the first; which frightened them so much, that they both ran precipitately to the other end of the drift. They then went down to another miner, who worked about twelve yards below them. He told them that the violence of the second shock had been so great, that it caused the rocks to grind upon one another. His account was interrupted by a third shock, which, after an interval of four or five minutes, was succeeded by a fourth; and, about the same space of time after, by a fifth; none of which were so violent as the second. They heard, after

every shock a loud rumbling in the bowels of the earth, which continued about half a minute, gradually descending, or seeming to remove to a greater distance.

At SHIRBURN CASTLE, Oxfordshire, a little after ten in the morning, a very strange motion was observed in the water of a moat which encompasses the building. There was a pretty thick fog, not a breath of air, and the surface of the water all over the moat as smooth as a looking-glass, except at one corner, where it flowed into the shore, and retired again successively, in a surprising manner. How it began to move is uncertain, as it was not then observed. The flux and reflux, when seen were quite regular. Every flood began gently, its velocity increasing by degrees, until at length it rushed in with great impetuosity, till it had attained its full height. Having remained for a little time stationary, it then retired, ebbing gently at first, but afterwards sinking away with great swiftness. At every flux the whole body of water seemed to be violently thrown against the bank; but neither during the time of the flux, nor that of the reflux, did there appear even the least wrinkle of a wave on the other parts of the moat. Lord Parker, who had observed this motion, being desirous to know whether it was universal over the moat, sent a person to the other corner of it, at the same time that he himself stood about twenty-five yards from him to examine whether the water moved there or not. He could not perceive any motion there; but another person, who went to the north-east corner of the moat, diagonally opposite to his lordship, found it as considerable there as where he was. His lordship imagining, that in all probability the water at the corner diagonally opposite to where he was would sink as that by him rose, ordered the person to signify by calling out, when the water by him began to sink, and when to rise. This he did; but to his lordship's great surprise, immediately after the water began to rise at his own end, he heard the voice calling that it began to rise with him also; and in the same manner he heard that it was sinking at his end, soon after he perceived it to sink by himself. A pond just below was agitated in a similar manner; but the risings and sinkings happened at different times from those at the pond where Lord Parker stood.

At WHITE ROCK, in Glamorganshire, about two hours

ebb of tide, and near three quarters after six in the evening, a vast quantity of water rushed up with a prodigious noise, floated two large vessels, the least of them above two hundred tons, broke their moorings, drove them across the river, and had like to have overset them. The whole rise and fall of this extraordinary body of water did not last above ten minutes, nor was it felt in any other part of the river, so that it seemed to have gushed out of the earth at that place.

Similar instances occurred at LOCH LOMOND and LOCH NESS, in Scotland. At KINSALE, in Ireland, and all along the coast to the westward, many similar phenomena were observed.

Shocks were also perceived in several parts of France, as at BAYONNE, BOURDEAUX, and LYONS; and commotions of the waters were observed at ANGOULESME, BELLEVILLE, HAVRE DE GRACE, &c. but not attended with the remarkable circumstances above mentioned.

These are the most striking phenomena with which the earthquake of November 1, 1755, was attended on the surface of the earth. Those which happened below ground cannot be known but by the changes observed in springs, &c. which were in many places very remarkable.

At TANGIER, all the fountains were dried up, so that there was no water to be had till night. A very remarkable change was observed in the medicinal waters of Toplitz, a village in Bohemia, famous for its baths. These waters were discovered in the year 762; from which time the principal spring had constantly thrown out hot water in the same quantity, and of the same quality. On the morning of the earthquake, between eleven and twelve, in the forenoon, this principal spring cast forth such a quantity of water, that in the space of half an hour all the baths ran over. About half an hour before this great increase of the water, the spring flowed turbid and muddy; then, having stopped entirely for a minute, it broke forth again with prodigious violence, driving before it a considerable quantity of reddish ochre. After this, it became clear, and flowed as pure as before. It still continued to do so, but the water was in greater quantity, and hotter, than before the earthquake At Angoulesme, in France, a subterraneous noise, like thunder, was heard; and presently after,

the earth opened, and discharged a torrent of water, mixed with red sand. Most of the springs in the neighbourhood sunk in such a manner, that for some time they were thought to be quite dry. In Britain, no considerable alteration was observed in the earth, except that, near the lead-mine above-mentioned, in Derbyshire, a cleft was observed about a foot deep, six inches wide, and one hundred and fifty yards in length.

At sea the shocks of this earthquake were felt most violently. Off St Lucar, the Captain of the Nancy frigate felt his ship so violently shaken, that he thought she had struck the ground; but, on heaving the lead, found she was in a great depth of water. Captain Clark, from Denia, in north latitude thirty-six degrees twenty-four minutes, between nine and ten in the morning, had his ship shaken and strained as if she had struck upon a rock, so that the seams of the deck opened, and the compass was overturned in the binnacle. The Master of a vessel bound to the American islands, being in north latitude twenty-five degrees, west longitude forty degrees, and writing in his cabin, heard a violent noise as he imagined, in the steerage; and while he was asking what the matter was, the ship was put into a strange agitation, and seemed as if she had been suddenly jerked up, and suspended by a rope fastened to the mast-head. He immediately started up with great terror and astonishment; and looking out at the cabin-window, saw land, as he took it to be, at the distance of about a mile. Coming upon the deck, the land was no more to be seen, but he perceived a violent current cross the ship's way to the leeward. In about a minute, this current returned with great impetuosity; and at a league's distance, he saw three craggy-pointed rocks throwing up waters of various colours, resembling fire. This phenomenon, in about two minutes, ended in a black cloud, which ascended very heavily. After it had risen above the horizon, no rocks were to be seen; though the cloud, still ascending, was long visible, the weather being extremely clear. Between nine and ten in the morning, another ship, forty leagues west of St. Vincent, was so strongly agitated, that the anchors, which were lashed, bounced up, and the men were thrown a foot and a half perpendicularly up from the deck. Immediately after this,

the ship sunk in the water as low as the main-chains. The lead showed a great depth of water, and the line was tinged of a yellow colour, and smelt of sulphur. The shock lasted about ten minutes; but they felt smaller ones for the space of twenty-four hours.'

EARTHQUAKES IN SICILY, AND IN THE TWO CALABRIAS.

These Earthquakes began on the 5th of February, 1783, and continued until the latter end of the May following, doing infinite damage, and exhibiting at Messina, in the parts of Sicily nearest to the Continent, and in the two Calabrias, a variety of phenomena. The part of the Calabrian provinces most affected by this heavy calamity, lies between the thirty-eighth and thirty-ninth degrees of latitude, being the extreme point of the Continent; and the greatest force of the earthquakes was exerted at the foot of the particular mountains of the Appenines, named Monte Deio, Monte Sacro, and Monte Caulone, extending westward to the Tyrrhene sea. The towns, villages, and farm-houses, nearest to these mountains, whether situated on the hills, or in the plains, were totally ruined by the first shock, which happened about noon; and there the destruction of lives was the greatest. The towns still more remote, were, however, greatly damaged by the subsequent shocks, particularly those of the 7th, 26th, and 28th of February, and that of the 1st of March. The earth was in a constant tremour, and its motions were various, being either vortical, or whirling round, horizontal, or oscillatory, that is, by pulsations or beatings, from the bottom upwards. This variety increased the apprehensions of the unfortunate inhabitants, who momentarily expected that the earth would open beneath their feet, and swallow them up. The rains had been continual and violent, often accompanied by lightning and furious gusts of wind. There were many openings and cracks in the earth; and several hills had been lowered, while others were quite level. In the plains, the chasms were so deep, that many roads were rendered impassable. Huge mountains were severed, and portions of them driven into the vallies, which were thus filled up.

The course of several rivers was changed; and many springs of water appeared in places which had before been perfectly dry.

From the city of Amantea, situated on the coast of the Tyrrhene Sea, in lower Calabria, proceeding along the western coast to Cape Spartivento, in upper Calabria, and thence along the eastern coast to Cape Alice, a part of Lower Calabria, on the Ionian Sea, the towns and villages, amounting to nearly four hundred, whether on the coast or *inland*, were either totally destroyed, or suffered greatly. At Casal Nuovo, the Princess Gerace, and upwards of four thousand of the inhabitants, lost their lives. At *Bagnara*, the number of dead amounted to upwards of three thousand; and Radicina and Palmi experienced a similar loss. The total amount of the mortality occasioned by these earthquakes, in Sicily and the two Calabrias, was, agreeably to the official returns, thirty-two thousand three-hundred and sixty-seven; but Sir William Hamilton thought it still greater, and carries his estimate to forty thousand, including foreigners.

On the first shock of the earthquake, on the 5th of February, the inhabitants of Scylla escaped from their houses, built on the rock, and, following the example of their prince, took shelter on the sea-shore. By this shock the sea had been raised and agitated so violently, that much damage had been done on the point of the Faro of Messina; but here it acted with still greater violence, for, during the night, an immense wave, which was falsely represented to have been boiling hot, and to have scalded many persons on its rising to a great height, flowed furiously three *miles* inland, and swept off in its return two-thousand four hundred and seventy-three of the inhabitants, with the prince at their head, who were either at that time on the strand, or in boats near the shore.

The shocks felt since the commencement of these formidable earthquakes, amounted to several hundreds; and among the most violent may be reckoned the one which happened on the 28th of March. It affected most of the higher part of Upper Calabria, and the inferior part of Lower Calabria, being equally tremenduous with the first. Indeed these shocks were the only ones sensibly felt in the capital, Naples. With relation to the former, two singular

phenomena are recorded; at the distance of about three miles from the ruined city of Oppido, in Upper Calabria, was a hill, having a sandy and clayey soil, nearly four hundred feet in height, and nearly nine hundred feet in circumference at its basis. This hill is said to have been carried to the distance of about four miles from the spot where it stood, into a plain called *Campo di Basegno*. At the same time, the hill on which the city of Oppido stood, and which extended about three miles, divided into two parts: being situated between two rivers, its ruins filled up the valley, and stopped their course, forming two large lakes, which augmented daily.

The accounts from Sicily were of a most alarming nature. The greatest part of the fine city of Messina was destroyed by the shock of the 5th of February, and what remained was greatly injured by the subsequent shocks. The quay in the port had sunk considerably, and was in some places more than a foot beneath the water. The superb building, called the Palazzata, which gave the port a more magnificent appearance than any other in Europe could boast, was entirely thrown down; and the lazaretto greatly damaged. The citadel suffered little; but the cathedral was destroyed, and the tower at the point of the entrance of the harbour much damaged. The wave which had done so much mischief at Scylla, had passed over the point of land at the Faro, and swept away twenty-four persons. The accounts from Melazzo, Patti, Terra di Santa Lucia, Castro Reale, and from the island of Lipari, were very distressing; but the damages done there by the earthquakes not so considerable as at Messina.

Sir William Hamilton, from the limited boundaries of these earthquakes, was persuaded that they were caused by some great operation of nature, of a volcanic kind. To ascertain this, he began his tour by visiting the parts of the coasts of the two Calabrias which had suffered most from this severe visitation. He every where came to ruined towns and houses, the inhabitants of which were in sheds, many of them built on such insalubrious spots, that an epidemic had ensued. These unfortunate people agreed that every shock they had felt, seemed to come with a rumbling noise from the westward, beginning usually with the horizontal motion, and ending with the vertical, or

whirling motion, which last had ruined most of the buildings. It had also been generally observed, that, before a shock, the clouds seemed to be fixed and motionless; and that, after a heavy shower of rain, a shock quickly followed. By the violence of some of the shocks, many persons had been thrown down; and several of the peasants described the motion of the earth as so violent, that the tops of the largest trees almost touched the ground from side to side. During a shock, the oxen and horses, they said, kept their legs wide asunder, to prevent being thrown down, and gave evident signs of being sensible of the approach of each shock. Being thus warned, the neighing of a horse, the braying of an ass, or the cackling of a goose, drove them from their temporary huts.

From Monteleone, Sir William descended into the plain, and passed many towns and villages in a ruined state: the city of Mileto, lying in a bottom, was totally destroyed, without a house standing. Among the many examples afforded by these earthquakes, of animals being able to live a long time without food, was that of two hogs, which had remained buried under a heap of ruins at Soriano for *forty-two days*, and were dug out alive. He had frequent opportunities to observe, that the habitations situated on high grounds, having a soil of a gritty sand-stone, somewhat like granite, but without its consistence, suffered less than those in the plain, the soil of which is a sandy clay. The latter were universally levelled with the ground. During the first shock he was told that a fountain of water, mixed with sand, had been forced to a considerable height: prior to this phenomenon, the river was dry, but soon returned and overflowed its banks. The other rivers in the plain underwent the like vicissitudes; to account for which, Sir William supposes the first impulsion of the earthquake to have come from the bottom upwards; and that such was the fact, the inhabitants attested. The surface of the plain having suddenly risen, the rivers, which are not deep, would naturally disappear; and the plain seeking with violence its former level, the rivers would necessarily return and overflow, at the same time that the sudden depression of the boggy grounds would as naturally force out the water which lay hidden beneath the surface.

It had been stated, in the reports made to government, that two tenements, named Macini and Vaticano, had, by the effect of the earthquake, changed their situation. In this fact Sir William agrees, and he accounts for it in the following manner:—They were situated in a valley surrounded by high grounds, and the surface of the earth, which had been removed, had probably been long undermined by the little rivulets which flow from the mountains, and were in full view on the bare spot the tenements had deserted. He conjectures besides, that, the earthquake having opened some depositions of rain-water in the clayey hills which surrounded the valley, the water, mixing with the loose soil, and taking its course suddenly through the undermined surface, had lifted it up, together with the large olive and mulberry trees, and a thatched cottage, floating the entire piece of ground, with all its vegetation, about a mile down the valley, where he saw it, with most of the trees erect. These two tenements occupied a space of ground about a mile in length, and half a mile in breadth. There were in the vicinity several deep cracks in the earth, not one of which was then more than a foot in breadth; but Sir William was credibly assured, that, during the earthquake, one had opened wide, and had swallowed up an ox, and nearly a hundred goats. In this valley he saw hollows, in the form of inverted cones, from which water and sand had been ejected violently at the time of the earthquakes, similar to those which had been pointed out to him at Rosarno. As well at the latter place, as in every ruined town he visited, an interesting remark was made to him, namely, that the male dead were generally found under the ruins, in the attitude of struggling against the danger; but that the attitude of the females was usually with the hands clasped over the head, as if giving themselves up to despair, unless they had children near them: in this case they were always found clasping them in their arms, or in some attitude which indicated their anxious care to protect them. How striking an instance of maternal tenderness!

Sir William travelled four days in the plain, in the midst of indescribable misery. Such was the force of the first shock, on the 5th of February, that the inhabitants of the towns were buried in an instant beneath the ruins of their

houses. Of the population of the town of Polistene, which was badly situated between two rivers, subject to overflow their banks, two thousand one hundred individuals perished out of six thousand. It was built near a ravine of great depth; and, by the violent motion of the earth, two huge portions of the ground on which a considerable part of the town, consisting of several hundreds of houses, stood, were detached into the ravine, and nearly across it, to the distance of about half a mile from their original position. What was most extraordinary, many of the inhabitants of these houses, who had taken this singular leap in them, were dug out alive, and several unhurt. Terra Nuova lost three-fourths of a population of sixteen hundred inhabitants; and near to this town, and to the ravine, many acres of land covered with trees and corn-fields, had been detached and thrown into the latter, often without having been overturned, insomuch that the trees and crops were growing as well as if they had been planted there. Other such pieces of ground were lying in the bottom, in an inclined situation; and others, again, were quite overturned. Two immense portions of land, having been detached opposite to each other, filled the valley, and stopped the course of the river, the waters of which formed a great lake.

Having walked over the ruins of Oppido, Sir William descended into the ravine, which he carefully examined. Here he saw the wonderful force of the earthquake, which had produced exactly the same effects as in the ravine of Terra Nuova, but on a scale infinitely greater. The enormous masses of the plain, detached from each side of the ravine, lay in confused heaps, forming real mountains; and, having stopped the course of two rivers, great lakes were formed. He occasionally met with a detached piece of the surface of the plain, many acres in extent, with the large oaks and olive-trees, having lupins and corn beneath them, growing as well, and in as good order at the bottom of the ravine, as their companions, from which they had been separated, did in the plain, at least five hundred feet higher, and at the distance of about three-quarters of a mile. Entire vineyards, which had taken a similar journey, were in the same order in the bottom. In another part of the ravine was a mountain, composed of a clayey soil,

which was probably a portion of the plain, detached by an earthquake at some former period: it was in height about two hundred and fifty feet, and about four hundred feet in diameter at its basis. It was well attested, Sir William observes, that this mountain travelled down the ravine nearly four miles, having been put in motion by the first shock. The abundance of rain which fell at that time; the great weight of the newly-detached pieces of the plain, which were heaped up at its back; the nature of its soil; and particularly its situation on a declivity; in his opinion satisfactorily account for this phenomenon. The Prince of Cariati showed him two girls, one of the age of about sixteen years, who had remained eleven days without food under the ruins of a house in Oppido; and the other, about eleven years of age, who had been under the same circumstances six days, but in a very confined and distressing posture.

Sir William describes the port of Messina, and the town, in their half-ruined state, when viewed by moonlight, as strikingly picturesque. On landing, he was assured by several fishermen, that, during the earthquake of the 5th of February, at night, the sand near the sea was hot, and that in many parts they saw fire issue from the earth. This had been often repeated to him in the Calabrian plain; and the idea he entertained was, that the exhalations which issued during the violent commotions of the earth, were full of electric fire, just as the smoke of volcanoes is constantly observed to be during violent eruptions; for he did not, during any part of his tour, perceive an indication of volcanic matter having issued from the fissures of the earth. He was, therefore, convinced that the whole damage had been done by exhalations and vapours only. In this city, where they had so long an experience of earthquakes, he was told, that all animals and birds are, in a greater or less degree, more sensible of an approaching shock of an earthquake than any human being; but that geese, above all, were the soonest and the most alarmed at the approach of a shock: if in the water, they quit it immediately, and they cannot be driven into it for some time after.

The force of the earthquakes, although very violent at Messina, and at Reggio on the opposite side of the strait,

was not to be compared to that which was felt in the plain. In the former city the mortality did not exceed seven hundred, of a population of thirty thousand. A curious circumstance happened there also, to prove that animals can sustain life for a long time without food. Two mules belonging to the Duke of Belviso, remained under a heap of ruins, the one twenty-two, and the other twenty-three days: for some days after they refused their food, but drank plentifully, and finally recovered. There were numberless instances of dogs remaining many days in the same situation; and a hen, belonging to the British Vice-consul, having been closely shut up beneath the ruins of his house, was taken out on the twenty-second day, and recovered, although at first it showed but little signs of life: like the mules, it did not eat for some days, but drank freely. From these instances, and from those above related, of the girls at Oppido, and the hogs at Soriano, as well as from several others of the same kind, it may be concluded, that long fasting is always attended with great thirst, and a total loss of appetite.

A circumstance worth recording, and which was observed throughout the whole coast of the part of the Calabrian provinces which had been most affected by the earthquakes, was, that a description of small fishes, named *cicirelli*, resembling what in England are called white-bait, but larger, and which usually lie at the bottom of the sea, buried in the sand, were, from the commencement of these earthquakes, and for a considerable time after, taken near the surface, and in such abundance as to become the common food of the poorer sort of people; whereas, before these events, they were rare, and reckoned among the greatest delicacies. Fishes in general having been taken, wherever the effects of the shocks had reached, in much greater abundance, and with greater facility, than before, Sir William conjectures, either that the bottom of the sea may have been heated by the volcanic fire beneath it, or that the continual tremor of the earth had driven the fishes out of their strong holds, in the same way as an angler, when he wants a bait, obliges the worms to come out of a turf on the river-side, by trampling on it with his feet, which motion never fails of its effect.

The Commandant of the Citadel of Messina, assured

him, that on the fatal 5th of February, and the three following days, the sea, at the distance of about a quarter of a mile from that fortress, rose and boiled in a most extraordinary manner, and with a horrid and alarming noise, while the water in the other parts of the Faro was perfectly calm. This appeared to him to point out exhalations or eruptions from cracks at the bottom of the sea, which were probably made during the violence of the earthquakes; and to these phenomena he ascribes a volcanic origin. He thus attempts to explain the nature of the formidable wave which was represented as boiling hot, and which, as has been already noticed, was so fatal to the inhabitants of Scylla.

Sir William concludes by remarking, that the local earthquakes here described, appear to have been caused by the same kind of matter as that which gave birth to the Æolian or Lipari isles. He conjectures that an opening may have been made at the bottom of the sea, most probably between Stromboli and Upper Calabria; for from that quarter, it was on all hands agreed, the subterraneous noises seemed to proceed. He adds, that the foundation of a new island, or volcano, may have been laid, although it may be ages, which to nature are but moments, before it shall be completed, and appear above the surface of the sea. Nature is ever active; but her acts are in general carried on so very slowly, as scarcely to be perceptible to the mortal view, or recorded in the very short space of what we call history, let it be ever so ancient. It is probable, also, he observes, that the whole of the destruction he has described, may have simply proceeded from the exhalations of confined vapours, generated by the fermentation of such minerals as produce volcanoes, which would escape where they met with the least resistance, and would consequently affect the plain in a greater degree than the high and more solid grounds by which it is surrounded.

Count Francesco Ippolito, in speaking of the last great shock of the 28th of March, as it affected the Calabrian territory, is persuaded that it arose from an internal fire in the bowels of the earth, as it took place precisely in the mountains which cross the neck of the peninsula, formed by the two rivers, the Lameto and the Corace, the former of which flows into the Gulf of St. Euphemia, and the

latter into the Ionian Sea. All the phenomena it displayed, made this evident. Like the other shocks, it came in a south-west direction: the earth at first undulated, then shook, and finally rocked to-and-fro to such a degree, that it was scarcely possible to stand. It was preceded by a terrible groan from beneath the ground; and this groan, which was of the same duration with the shock, terminated with a loud noise, like that of the explosion of a mine. These thunderings accompanied not only the shock of that night, and of the succeeding day, but likewise all the others which were afterwards felt; at the same time that the earth was continually shaken, at first every five minutes, and subsequently each quarter of an hour. During the night, flames were seen to issue from the ground in the neighbourhood of Reggio, towards the sea, to which the explosion extended, insomuch that many of the peasants ran away through fear. These flames issued precisely from a spot where some days before an extraordinary heat had been perceived. After this great shock there appeared in the air, in a slanting direction, and towards the east, a whitish flame, resembling electric fire: it was seen for the space of two hours.

Several hills were either divided or laid level; and within the surface of the earth apertures were made, from which a great quantity of water, proceeding either from subterraneous concentrations, or from the rivers adjacent to the ground thus broken up, spouted for several hours. From one of these openings, in the territory of Borgia, and about a mile from the sea, there issued a large quantity of salt water, which for several days imitated the motions of the sea. Warm water likewise issued from the apertures made in the plains of Maida. In all the sandy parts, where the explosion took place, there were observed, from distance to distance, apertures in the form of an inverted cone, emitting water, and which seemed to prove the escape of a flake of electric fire.

Amid the various phenomena which either preceded or followed this particular shock, the following are well deserving of notice. The water of a well at Maida, which was of an excellent quality, was affected, just before the shock, with so disgustful a sulphureous flavour, that it could not even be smelt to. On the other hand, at Catan-

zaro, the water of a well, which before could not be used, on account of its possessing a strong smell of calcination, became potable. For a long time before the earth shook, the sea was considerably agitated, so as to terrify the fishermen, at the same time that there was not a breath of wind. On the side of Italy, the volcanoes had not emitted any eruptions for a considerable time before; but in the same way as, during the first great shock, Etna was in flames, so Stromboli emitted fire during this last.

EARTHQUAKES IN PERU, &c.

South America has been at all times very subject to earthquakes; and it is remarkable, that the city of Lima, the capital of Peru, situated in about twelve degrees of south latitude, although scarcely ever visited by tempests, and equally unacquainted with rain as with thunder, and lightning, has been singularly exposed to their fury. They, indeed happen so frequently there, that the inhabitants are under continual apprehensions of being, from their suddenness and violence, buried beneath the ruins of their houses. Still they have their presages, one of the principal of which is a rumbling noise in the bowels of the earth, heard about a minute before the shocks are felt, and seeming to pervade all the subterraneous adjacent parts. This is followed by the dismal howlings of the dogs, who seem to give notice of the approaching danger; while the beasts of burden, in their passage through the streets, stop suddenly, as it were by a natural instinct, and seek the attitude which may best secure them from falling. On these portents, the terrified inhabitants flee from their houses into the streets, forming large assemblies, in the midst of which cries of children are blended with the lamentations of the females, whose agonizing prayers to the saints increase the common fear and confusion. In a word, the entire city exhibits a dreadful scene of consternation and horror.

Since the establishment of the Spaniards in Peru, the first earthquake in this capital happened in 1582; but the damage it did was much less considerable than that of some of those which succeeded. Six years after Lima was again visited by an earthquake, the results of which were

so dreadful, that it is still solemnly commemorated every year. In 1609, a third convulsion threw down many houses: and on the 27th of November, 1630, so much damage was done by an earthquake, that in acknowledgement of the city not having been entirely demolished, a festival is also on that day annually celebrated. On the 3d of November, 1654, the most stately edifices in Lima, and a great number of houses, were destroyed by a similar event; but the inhabitants having had timely presages, withdrew themselves from their houses, insomuch that few perished. In 1678, another dreadful concussion took place.

Among the most tremendous earthquakes with which the Peruvian capital has been visited, may be reckoned that which happened on the 28th of October, 1687. The first shock was at four in the morning, when several of the finest public buildings and houses were destroyed, with the loss of many lives. This was, however, merely a prelude to what followed; for, two hours after, a second shock was felt, with such impetuous concussions, that all was laid in ruins, and every description of property lost. During this second shock the sea retired considerably, and then returned in mountainous waves, entirely overwhelming Callao, the sea-port of Lima, distant five miles, as well as the adjacent country, together with the wretched inhabitants. From that time six other earthquakes were felt at Lima, prior to that of 1746, which likewise happened on the 28th of October, at half past ten at night. The early concussions were so violent, that in the space of somewhat more than three minutes, the greater part, if not all, the buildings in the city were destroyed, burying under their ruins such of the inhabitants as had not made sufficient haste into the streets and squares, the only places of safety. At length the horrible effects of the first shock ceased; but the tranquility was of short duration, the concussions swiftly succeeding each other. The fort of Calloa was dilapidated; but what this building suffered from the earthquake, was inconsiderable when compared with the dreadful catastrophe which followed. The sea, as is usual on such occasions, receding to a considerable distance, returned in mountainous waves, foaming with the violence of the agitation, and suddenly buried Callao and the neigh-

bouring country in its flood. This, however, was not entirely effected by the first swell of the waves; for the sea, retiring still farther, returned with greater impetuosity, and covered not only the buildings, but also the lofty walls of the fortress: so that what had even escaped the first inundation, was totally overwhelmed by these succeeding mountainous waves. Of twenty-three ships, and vessels of light burden, then in the harbour, nineteen were sunk; and the four others, among which was a frigate, named the San Firmin, were carried by the force of the waves to a considerable distance up the country. This terrible inundation extended, as well as the earthquake, to other parts of the coast, and several towns underwent the fate of Lima. The number of persons who perished in that capital, within two days after the earthquake commenced, on an estimate of the bodies found, amounted to thirteen hundred, beside the wounded and maimed, many of whom survived their tortures but a short time.

The earthquake of Jamaica, in 1692, was one of the most dreadful history has had to record. In the space of two minutes it destroyed the town of Port Royal, and sunk the houses in a gulph forty fathoms deep. It was attended with a hollow rumbling noise, like that of thunder. In less than a minute, the greater part of the houses, on one side of the streets, were, with their inhabitants, sunk beneath the water, while those on the other side were thrown into heaps, the sandy soil on which they were built rising like the waves of the sea, and suddenly overthrowing them on its subsidence. The water of the wells was discharged with a most vehement agitation; and the sea was equally turbulent, bursting its mounds, and deluging whatever came in its way. The fissures in the earth were in some places so great, that one of the streets appeared of more than twice its original breadth. In many places the earth opened and closed again; and this agitation continued for a considerable time. Several hundreds of these openings were to be seen at the same moment: in some of them the wretched inhabitants were swallowed up; while in others, the earth suddenly closing, caught them by the middle, and thus crushed them to death. Other openings, still more dreadful, swallowed up entire streets; while others, again, spouted up cataracts of water, drowning

those whom the earthquake had spared. The whole was attended with a most noisome stench. The thunderings of the distant falling mountains; the sky overcast with a dusky gloom; and the crash of the falling buildings; gave unspeakable horror to the scene. This dreadful calamity having ceased, the whole island exhibited a scene of desolation. Few of the houses which had not been swallowed up were left standing; and whatever grew on the plantations shared in the universal ruin. These cultivated spots were now converted into large pools of water, which when dried up by the sun, left so many plains of barren sand. The greater part of the rivers had, during the earthquake, been choked by the falling in of the detached masses of mountains; and it was not until some time after, that they made themselves new channels. The mountains seem to have been more particularly exposed to the force of the first tremendous shock; and it was conjectured, that the principal seat of the concussion was among them. Such of the inhabitants as were saved, sought shelter on board the ships in the harbour, and remained there above two months, the shocks continuing during that interval with more or less violence every day.

EARTHQUAKES IN VENEZUELA.

On the 26th of March, 1812, between four and five p. m. Venezuela was visited by one of those tremendous earthquakes, which from time to time ruin whole provinces. During a minute and fifteen seconds the earth was convulsed in every direction, and nearly twenty thousand persons fell victims. The towns of Caraccas, La Guayra, Mayquetia, Merida, and Sanfelipe, were totally destroyed. Barquisimeto, Valencia, La Vittoria, and others, suffered considerably. This catastrophe happened on Holy Thursday, a day when every Christian church peculiarly commemorates the sufferings of our blessed Redeemer, and at the very hour when the people were crowding into the churches to attend the processions which are usual in Roman Catholic Countries, and to see the representation of our Saviour led to the cross. Troops are placed on such occasions at the entrance of the churches to follow the

procession; and many churches, and the principal barracks at Caraccas, being thrown down, there was a considerable number of soldiers killed, and many thousand persons crushed under their ruins. The arms and ammunition destined for the defence of the country were buried in a similar manner; and what was worse, an unconquerable enemy to the independence of Venezuela seemed to raise its head from among the ruins—that religious prejudice which the earthquake inspired.

In an era less remarkable, a mere convulsion of nature would have had no influence on a new government; but, notwithstanding the prosperity Venezuela then enjoyed, the seeds of discontent had fallen on one class of the community. The principles which formed the basis of the new constitution were democratical, and it had been necessary to deprive the clergy of some of their privileges, which of course created enmity in their minds to the present government. Immediately after the earthquake, the priests proclaimed, that the Almighty condemned the revolution: they denounced his wrath on all who favoured it; and a counter-revolution, attended by great bloodshed, was the unhappy consequence.

CONNEXION OF EARTHQUAKES WITH VOLCANOES.

ISLAND OF JAVA.

The connexion of earthquakes with volcanoes has been already noticed; and a remarkable instance of an occurrence of this nature is recorded in Raffles' History of Java. Papandayang was formerly one of the largest volcanoes in that island; but in the month of August, 1772, the greatest part of it was, after a short but severe combustion, swallowed up by a dreadful convulsion of the earth. This event was preceded by an uncommonly luminous cloud, by which the mountain was completely enveloped, and which so terrified the inhabitants dwelling at the foot and on its declivities, that they betook themselves to flight. Before they could all save themselves, however, the mountain began to give way, and the greater part of it actually

fell in and disappeared in the earth. At the same time, a tremendous noise was heard, resembling the discharge of the heaviest cannon; while the immense quantities of volcanic substances which were thrown out, and spread in every direction, propagated the effects of the explosion through the space of many miles.

It was estimated that an extent of ground, belonging to the mountain itself, and to its immediate environs, fifteen miles in length, and six in breadth, was by this commotion swallowed up in the bowels of the earth. Six weeks after the catastrophe, persons who were sent to examine the condition of the surrounding territory, reported, that it was impossible to approach the mountain, on account of the heat of the substances which covered its circumference, and which were piled on each other to the height of three feet. It has been reported, that forty villages, partly swallowed up by the opening of the earth, and partly covered by the substances ejected, were destroyed on this melancholy occasion, with the loss of nearly three thousand lives. A proportionate number of cattle was destroyed; and the greater part of the plantations of cotton, indigo, and coffee, in the adjacent districts, were buried beneath the volcanic matter. The effects of this explosion were long apparent on the remains of the volcanic mountain.

The very interesting work of Governor Raffles contains several curious and novel details relative to volcanic phenomena, a sketch of which is here introduced, on account of their intimate connexion with the subterraneous operations of nature, in the production of earthquakes. It may be considered as supplementary to the detailed account of volcanoes given at the commencement of this work.

There are in Java thirty-eight large mountains, which, although they differ from each other in external figure, agree in the general attribute of volcanoes, by their having a broad base, which gradually verges towards the summit, in the form of a cone. One of these is named Tankuban-Prahu, on account of its resembling, at a distance, a boat turned upside down; and forms a vast truncated cone. Its base extends to a considerable distance, and it is not only one of the largest mountains in the island, but a most interesting volcano. Although it has not for many ages had any violent eruption, as is evident

from the progress of vegetation, and from the depth of black mould which covers its sides, its interior has continued in a state of uninterrupted activity. Its crater is large, and has, in general, the shape of a funnel, but with its sides very irregular: the brim, or margin, which bounds it at the top, has also different degrees of elevation, rising and descending along the whole course of its circumference. This may be estimated at a mile and half; and the perpendicular depth on the south-side, where it is very steep, is at least two hundred and fifty feet: towards the west it rises considerably higher. The bottom of the crater has a diameter of nine hundred feet, but is not regular in its form, which depends on the meeting of the sides below. Near the centre it contains an irregular oval lake, or collection of water, the greatest diameter of which is nearly three hundred feet. The water being white, it exhibits the appearance of a lake of milk, boiling with a perpetual discharge of large bubbles, occasioned by the development of fixed air. Towards its eastern extremity are the remaining outlets of the subterraneous fires, consisting of several apertures, from which an uninterrupted discharge of sulphureous vapours takes place. These vapours rush out with an incredible force, with violent subterraneous noises, resembling the boiling of an immense cauldron in the bowels of the mountain. When at the bottom, the force of the impression made on the spectator by this grand and terrific scene, is increased by the recollection of the dangers he had to encounter in the descent; while the extent of the crater, and the remains of the former explosions, afford an indescribable enjoyment, and fill his mind with the most awful satisfaction.

The explosions of mud, called by the natives *bledeg*, are a great curiosity. This volcanic phenomenon is in the centre of a limestone district, and is first discovered, on approaching it from a distance, by a large volume of smoke, which rises and disappears at intervals of a few seconds, and resembles the vapours arising from a violent surf. A dull noise, like that of thunder, is at the same time heard; and on a nearer approach, when the vision is no longer impeded by the smoke, a large hemispherical mass is observed, consisting of black earth, mixed with water, about sixteen feet in diameter, rising up to the

height of twenty or thirty feet in a perfectly regular manner and, as it were, pushed up by a force beneath. This mass suddenly explodes with a dull noise, and scatters, in every direction, a volume of black mud. After an interval of a few seconds, the hemispherical body of earth or mud again rises and explodes. In the same manner this volcanic ebullition goes on without interruption, throwing up a globular body of mud, and dispersing it with violence through the neighbouring plain. The spot where the ebullition occurs is nearly circular, and perfectly level, and is entirely covered with the earthy particles, impregnated with salt water, which are thrown up from below. The circumference may be estimated at about half a mile. In order to conduct the salt water to the circumference, small passages, or gutters, are made in the loose muddy earth, which lead it to the borders, where it is collected in holes, or salt wells, dug in the ground, for the purpose of evaporation. The mud recently thrown up, possesses a degree of heat greater than that of the surrounding atmosphere, and emits a strong, pungent, and sulphureous smell. This volcanic phenomenon is situated near the centre of the large plain which interrupts the series of the more considerable volcanoes, and owes its origin to the general cause of the numerous volcanic eruptions which occur in the Island of Java.

The tremendous violence with which nature marks the operations of volcanoes in these regions, will be best exemplified by the following details of the extraordinary and wide-spreading phenomena which accompanied the eruption of the Tomboro mountain, in the island of Sumbawa, one of the Javanese cluster. This eruption, which happened in April, 1815, was sensibly felt over the whole of the Molucca islands, over Java, and over a considerable portion of Celebes, Sumatra, and Borneo, to a circumference of a thousand statute miles from its centre, by TREMULOUS MOTIONS and LOUD EXPLOSIONS; while, within the range of its more immediate activity, embracing a space of three hundred miles around it, it produced the most astonishing effects, and excited the most alarming apprehensions. On Java, at the distance of three hundred miles, it seemed to be awfully present. The sky was overcast at noon-day with a cloud of ashes; the sun was enveloped

in an atmosphere, the "palpable" density of which it was unable to penetrate; showers of ashes covered the houses, the streets, and the fields, to the depth of several inches; and, amid this darkness, explosions were heard at intervals, like the report of artillery, or the noise of distant thunder. Every one conceived, that the effects experienced might be caused by eruptions of some of the numerous volcanoes on the island; but no one could have conjectured, that the shower of ashes which darkened the air, and covered the ground of the eastern district of Java, could have proceeded from a mountain in Sumbawa, at the distance of several hundred miles.

The first explosions were heard at Java, on the evening of the 5th of April, and continued until the following day, when the sun became obscured, and appeared to be enveloped in a fog. The weather was sultry; the atmosphere close; and the pressure of the latter, added to the general stillness, seemed to forebode an earthquake. This lasted for several days, the explosions continuing, but not with so much violence as at first. On the evening of the 10th, the eruptions, however, were more loud and more frequent; ashes fell in abundance; the sun was nearly obscured; and in several parts of the island a TREMULOUS MOTION OF THE EARTH was felt. On the following day, the explosions were so tremendous as to shake the houses perceptibly in the more eastern districts.

In the Island of Sumbawa itself, there was a great loss of lives, and the surviving inhabitants were reduced to extreme misery. It appears from the account of the Rajah, who was a spectator of the eruption, that on the evening of the 10th of April, three distinct columns of flame, all apparently within the verge of the crater of the Tomboro mountain, burst forth, and, after ascending separately to a very great height, united their tops in the air. The whole of the mountain now appeared like a body of liquid fire, extending itself in every direction. Stones and ashes were precipitated; and a whirlwind ensued, which blew down the greater part of the houses in an adjoining village. It tore up by the roots the largest trees, and carried them into the air, together with men, horses, cattle, and whatever came within its influence. The sea rose nearly twelve feet higher than usual,—a phenomenon commonly attend-

ant on earthquakes,—overwhelming the plantations of rice, and sweeping away houses, with whatever came within its reach. It is calculated that twelve thousand individuals perished. The trees and herbage of every description, along the whole of the north and west sides of the peninsula, were completely destroyed, with the exception of a high point of land near the spot where the village of Tomboro stood.

The extreme misery to which the inhabitants of the western part of the island were reduced, was dreadful to behold. The roads were strewed with dead bodies; the villages were almost entirely deserted, and the houses fallen down. The peasants wandered in all directions in search of food; and the famine became so severe, that one of the daughters of the Rajah died of hunger.

To judge of the violence of the eruption, it will suffice to state, that the cloud of ashes which had been carried with so much celerity as to produce utter darkness, extended, in the direction of the Island of Celebes, two hundred and seventeen nautical miles from the seat of the volcano; and, in a direct line towards Java, upwards of three hundred geographical miles.

BASALTIC AND ROCKY WONDERS.

THE GIANT'S CAUSEWAY.

This vast collection of basaltic pillars is in the vicinity of Ballimony, in the county of Antrim, Ireland. The principal, or grand causeway, (there being several less considerable and scattered fragments of a similar nature) consists of an irregular arrangement of many hundred thousands of columns, formed of a black rock, nearly as hard as marble. The greater part of them are of a pentagonal figure, but so closely and compactly situated on their sides, though perfectly distinct from top to bottom, that scarcely any thing can be introduced between them. These columns are of an unequal height and breadth: several of the most elevated, visible above the surface of the strand, and at the foot of the impending angular precipice, are of the height of about twenty feet, which they do not exceed, at least not any of the principal arrangement. How

deeply they are fixed in the strand, has never yet been ascertained.

This grand arrangement extends nearly two hundred yards, as it is visible at low water; but how far beyond is uncertain: from its declining appearance, however, at low water, it is probable that it does not reach beneath the water to a distance equal to that which is seen above. The breadth of the principal causeway, which runs out in one continued range of columns, is in general from twenty to thirty feet: in some parts it may, for a short distance, be nearly forty. From this account are excluded the broken and scattered pieces of the same kind of construction, which are detached from the sides of the grand causeway, as they do not appear to have ever been contiguous to the principal arrangement, although they have been frequently comprehended in the width, which has led to such wild and dissimilar representations of this causeway, in the different accounts that have been given. Its highest part is the narrowest, at the very spot of the impending cliff, whence the whole projects; and there, for about the same space in length, its width is not more than from twelve to fifteen feet. The columns of this narrow part incline from a perpendicular a little to the westward, and form a slope on their tops, by the unequal height of their sides; and in this way a gradual ascent is made at the foot of the cliff, from the head of one column to the next above, to the top of the great causeway, which, at the distance of about eighteen feet from the cliff, obtains a perpendicular position, and lowering from its general height, widens to between twenty and thirty feet, being for nearly three hundred feet always above the water. The tops of the columns being, throughout this length, nearly of an equal height, form a grand and singular parade, which may be walked on, somewhat inclining to the water's edge. But from the high water mark, as it is perpetually washed by the beating surges, on every return of the tide, the platform lowers considerably, becoming more and more uneven, so as not to be walked on but with the greatest care. At the distance of a hundred and fifty yards from the cliffs, it turns a little to the east, for the space of twenty or thirty yards, and then sinks into the sea. The figure of these columns is, with few exceptions, pentagonal, or composed

of five sides; and the spectator must look very narrowly indeed to find any of a different construction, having three, four, or six sides. What is very extraordinary, and particularly curious, is, that there are not two columns in ten thousand to be found, which either have their sides equal among themselves, or display a like figure.

The composition of these columns, or pillars, is not less deserving the attention of the curious observer. They are not of one solid stone in an upright position, but composed of several short lengths, nicely joined, not with flat surfaces, but articulated into each other like a ball and socket, or like the joints in the vertebræ of some of the larger kind of fish, the one at the joint having a cavity, into which the convex end of the opposite is exactly fitted. This is not visible unless on disjointing the two stones. The depth of the concavity or convexity is generally about three or four inches. It is still farther remarkable, that the convexity and correspondent concavity of the joint, are not conformable to the external angular figure of the column, but exactly round, and as large as the size or diameter of the column will admit; consequently, as the angles of these columns are in general very unequal, the circular edges of the joints are seldom coincident with more than two or three sides of the pentagonal, and are, from the edge of the circular part of the joint to the exterior sides and angles, quite plain. It ought likewise to be noticed as a singular curiosity, that the articulations of these joints are frequently inverted, in some of them the concavity being upwards, in others the reverse. This occasions that variety and mixture of concavities and convexities on the tops of the columns, which is observable throughout the platform of this causeway, without any discoverable design or regularity with respect to the number of either.

The length of these particular stones, from joint to joint, is various: they are in general from eighteen inches to two feet long; and for the greater part, longer towards the bottom of the columns than nearer the top, the articulation of the joints being there somewhat deeper. The size, or diameter, likewise of the columns is as different as their length and figure: in general they are from fifteen to twenty inches in diameter. Throughout the whole of this combination there are not any traces of uniformity or de-

sign, except in the form of the joint, which is invariably by an articulation of the convex into the concave of the piece next above or below it: nor are there traces of a finishing in any part, whether in the height, length, or breadth. If there be particular instances in which the columns above water have a smooth top, others near them, of an equal height, are more or less convex or concave, which shows them to have been joined to pieces that have been washed away, or by other means taken off. It cannot be doubted but that those parts which are constantly above water have gradually become more and more even, at the same time that the remaining surfaces of the joints must necessarily have been worn smoother, by the constant action of the air, and by the friction in walking over them, than where the sea, at every tide, beats on the causeway, continually removing some of the upper stones, and exposing fresh joints. All the exterior columns, which have two or three sides exposed to view, preserve their diameters from top to bottom, it may be inferred, that such is also the case with the interior columns, the tops of which alone are visible.

Notwithstanding the general dissimilitude of the columns, relatively to their figure and diameter, they are so arranged and combined at all the points, that a knife can scarcely be introduced between them, either at the sides or angles. It is most interesting to examine the close contexture and nice insertion of the infinite variety of forms exhibited on the surface of this grand parade. From the great dissimilarity of the figures of the columns, the spectator would be led to believe the causeway a work of human art, were it not, on the other hand, inconceivable that the genius or invention of man should construct and combine such an infinite number of columns, which should have a general apparent likeness, and still be so universally dissimilar in their figure, as that on the minutest examination, not two in ten or twenty thousand should be found having their angles and sides equal among themselves, or those of one column to those of another. As there is an infinite variety in the configuration of the several parts, so are there not any traces of regularity or design in the outlines of this curious phenomenon: including the broken or detached pieces of a similar structure, they are extremely

scattered and confused. Whatever may have been their original state, they do not at present appear to have any connection with the grand or principal causeway, as to any supposable design or use in its first construction; and as little design can be inferred from the figure or position of the several constituent parts.

The cliffs, at a great distance from the causeway, exhibit in many parts similar columns. At the depth of ten or twelve feet from the summit of the cape of Bengore the rock begins to assume a columnar tendency, and forms a range of massy pillars of basalt, which stand perpendicular to the horizon, presenting in the sharp face of the promontory, the appearance of a magnificent gallery or colonnade, upwards of sixty feet in height. This colonnade is supported on a solid base of coarse, black, irregular rock, nearly sixty feet thick, abounding in blebs and air holes; but, though comparatively irregular, it evidently affects a peculiar figure, tending in many places to run into regular forms, resembling the shooting of salts and many other substances during a hasty crystallization. Beneath this great bed of stone, stands a second range of pillars from forty to fifty feet high, more exactly defined, and emulating in the neatness of its columns, those of the Giant's Causeway. This lower range is upborne by a layer of red ochre stone, which serves as a relief to shew it to greater advantage. The two admirable natural galleries, with the interjacent masses of irregular rock, form a perpendicular height of one hundred and seventy feet, from the base of which the promontory, covered with rock and grass, slopes down to the sea a considerable space, so as to give an additional height of two hundred feet, making in all nearly four hundred feet of perpendicular elevation, and presenting a mass, which for beauty and variety of colouring, for elegance and novelty of arrangement, and for the extraordinary magnitude of its objects, cannot, perhaps, be rivalled by any thing at present known.

The promontory of Fairhead raises its lofty summit more than four hundred feet above the level of the sea, and forms the eastern termination of Ballycastle bay. It presents a vast compact mass of rude columnar stones, the forms of which are extremely gross, many being a hundred and fifty feet in length. At the base of these

gigantic columns lies a wild waste of natural ruins of an enormous size, which, in the course of successive ages, have been tumbled down from their foundations by storms, or some more powerful operations of nature. These massive bodies have occasionally withstood the shock of their fall, and often lie in groups, and clumps of pillars, resembling artificial ruins, and forming a very novel and striking landscape.

Many of these pillars lie to the east, in the very bottom of the bay, at the distance of about one-third of a mile from the causeway. There the earth has evidently fallen away from them upon the strand, and exhibits a very curious arrangement of pentagonal columns, in a perpendicular position, apparently supporting a cliff of different strata of earth, clay, rock, &c. to the height of a hundred and fifty feet. Some of these columns are from thirty to forty feet high, from the top of the sloping bank beneath them; and being longer in the middle of the arrangement, shortening on either of the sides, have obtained the appellation of *organs*, from a rude likeness in this particular to the exterior or frontal tubes of that instrument. As there are few broken pieces on the strand, near this assemblage of columns, it is probable that the outside range, as it now appears, is in reality the original exterior line towards the sea; but how far these columns extend internally into the bowels of the incumbent cliff is unknown. The very substance, indeed, of that part of the cliff which projects to a point, between the two bays on the east and west of the causeway, seems composed of similar materials; for, besides the many pieces which are seen on the sides of the cliff, as it winds to the bottom of the bays, particularly on the eastern side, there is at the very point of the cliff, and just above the narrow and highest part of the causeway, a long collection of them, the heads or summits of which just appearing without the sloping bank, make it evident that they lie in a sleeping position, and about half-way between the perpendicular and horizontal. The heads of these columns are likewise of mixed surfaces, convex and concave; and they evidently appear to have been removed from their original upright position, to the inclining or oblique one they have now assumed, by the sinking or falling of the cliff.

BASALTIC COLUMNS.

In the country surrounding Padua, in the State of Venice, there are several basaltic columns, similar to those of the Giant's Causeway, although less magnificent in appearance. About seven miles in a southern direction, from that city, is a hill named Monte Rosso, or the Red Mount, which presents a natural range of prismatic columns, of different shapes and sizes, placed in a direction nearly perpendicular to the horizon, and parallel to each other, nearly resembling that part of the Giant's Causeway, called "The Organs."

At an inconsiderable distance is another basaltine hill, called *Il monte del Diavolo*, or the Devil's Hill, along the sides of which prismatic columns are arranged in an oblique position. This causeway extends along the side of the vale beneath, nearly with the same arrangement of the columns as is displayed on the hill. Although the columns of both these hills are of the simple, or unjointed kind, still they differ very remarkably from each other in many respects, but principally in their forms, and in the texture and quality of their parts. Those of the Monte del Diavolo commonly approach a circular form, as nearly as their angles will allow; which is also observable in the columns of the Giant's Causeway, and of most other basaltic groups. On the contrary, those of Monte Rosso assume an oblong or oval figure. The columns of the former measure, one with the other, nearly a foot in diameter, varying but little in their size; while those of the latter present a great variety in their dimensions, the diameter of some of them being nearly a foot, and that of others scarcely three inches: their common width may be estimated at six or eight inches. They differ, therefore, very considerably in size from those of the Giant's Causeway, some of which mea sure two feet in width. The length of the columns of the Monte del Diavolo cannot be ascertained, as they present their summits only to the view: their remaining parts are deeply buried in the hill, and in some places entirely covered. Those of Monte Rosso, as far as they are visible, measure from six to eight or ten feet in height—an incon-

siderable size when compared with the height of those of the Giant's Causeway. The columns of the Venetian groupes display, however, all the varieties of prismatic forms, which are observable in those of the latter, and other similar groups. They are usually of five, six or seven sides; but the hexagonal form seems chiefly to prevail.

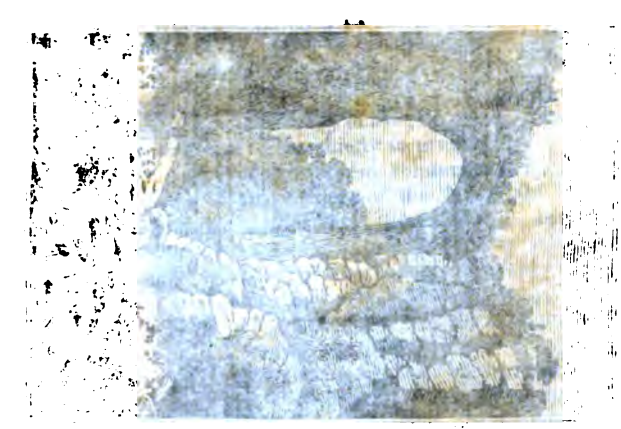
The texture and quality of these columns are not less different than their forms. Those of the Monte del Diavolo present a smooth surface, and, when broken, appear within of a dark iron-grey colour, manifesting also a very solid and uniform texture; in which characters they correspond with the columns of the Giant's Causeway, and those of most other basaltic groups. But the columns of Monte Rosso are in these respects very different, they having not only a very rough, and sometimes knotty, surface, but displaying likewise, when broken, a variegated colour and unequal texture of parts. They are commonly speckled, more or less distinctly, and resemble an inferior sort of granite, of which Monte Rosso is itself formed, and which serves as a base to the range of columns in question. It is, in general, not quite so hard as the Alpine and Oriental granites, and is sometimes even friable. This species of granite abounds in France, where large tracts of it are to be seen in the adjoining provinces of Auvergne, Vivarez, and Lionnois. But it is still more common in Italy, seeing that, besides Monte Rosso, the bulk of the Euganean hills, of which that is a part, principally consists of it; and these hills occupy a considerable tract in the plains of Lombardy. It is also common in the Roman and Tuscan States; and of this substance the mountain close to Viterbo, on the road to Rome, is entirely composed. The columns of Monte Rosso appear, therefore, of a different character from any hitherto described by mineralogists, who mention those only of an uniform colour and texture. But the great singularity here is, that such a range of prismatic columns should be found, bedded as it were, in a mass of granite, and composed nearly of the same substance. An instance of this kind, relative to any other causeway, is not recorded; and this circumstance seems to render that of Monte Rosso, in one respect at least, more curious and singular than the celebrated Giant's Causeway is known to be, from the regular articulation of

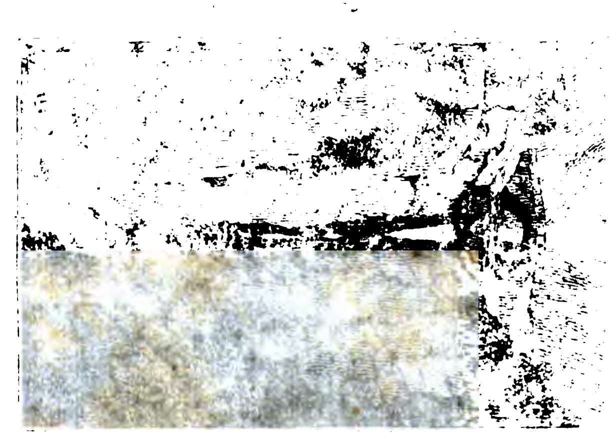


No. 35.—Rock Bridge, Virginia.



No. 34.—Natural Briges of Icononzo.





its columns. It is certain, that the basaltic group of Monte Rosso is not only highly curious in itself, but interesting on account of the great light it throws on the origin of granites in general.

It is likewise remarkable, that the columns, in the two groups of Monte Rosso and Monte del Diavolo, preserve respectively the same position, nearly parallel to each other; which is not usually the case in basaltic groups. For, although the principal aggregate of which the Giant's Causeway is formed, stands in a direction perpendicular to the horizon, still other small detached groups of columns also appear on the eminence above, assuming by their position different degrees of obliquity. Among the numerous basaltic hills of Auvergne and Velay in France, phenomena which seem to abound in those provinces more than in any other part of Europe, and, perhaps, of the known globe, nothing is more common than to see the columns of the same group lying in all possible directions, as irregularly almost as the prisms in a mass of common chrystal. Nor is this variety of position so observable in single columns as in whole masses or ranges of them, that often present themselves on the same hill, disposed in different strata or stages, as it were, one above the other, many of them assuming very different, and even opposite directions. The columns of the Monte del Diavolo are bedded in a kind of volcanio sand, by which, in many parts of the hill, they are entirely covered: it is probable, however, that they repose beneath on a base of basaltic rock of a similar nature. Nothing is more common, in the provinces of France, above mentioned, than to see insulated basaltic hills almost exclusively composed of different layers of columns, which present themselves in stages, one above the other, often without any other stratum between them, resembling in some measure, if the comparison can be allowed, a huge pile or stack of cleft wood. Although the columnar crystallization of Monte Rosso is the only one yet known or described, in a mass of granite, still other groups of columns have elsewhere been met with, which are equally of a heterogeneous substance or texture, however they may otherwise differ from those of Monte Rosso, as well as from the common basalts.

NATURAL BRIDGES.

NATURAL BRIDGES OF ICONONZO.

[*See Plate, No.* 34.]

AMID the majestic and varied scenery of the Cordilleras of South America, that of their valleys most forcibly strikes the imagination of European travellers. Their enormous height is not discoverable but at a considerable distance, and while the spectator is on one of those plains which extend from the sea-coasts to the foot of the central chain. The flats, or table lands, which surround the snow-clad summits of the mountains, are themselves, for the greater part, of an elevation of from seven to nine thousand feet, nearly a mile and three quarters, above the level of the sea. This circumstance diminishes, to a certain degree, the impression of greatness produced by the colossal masses of Chimborazo, Cotopaxi, and Antisana, when seen from the flats of Riobamba, or from those of Quito. It is not, however, with the valleys as with the mountains: deeper and narrower than those of the Alps and the Pyrenees, the valleys of the Cordilleras present situations still more wild than these, and more adapted to fill the soul with admiration and with terror. Fissures and chasms present themselves, having their bottoms and sides ornamented with a vigorous vegetation, and of such a depth, that Vesuvius and the Puy-de-Dome might be placed within several of them, and not show their summits above the edge of the neighbouring mountains. In passing along the back of the Andes, from Pasto to Villa d'Ibarra, and in descending the Loxa towards the banks of the river of the Amazons, the traveller reaches the celebrated fissures of Chota and Cutaco, the former of which is nearly a mile, and the latter upwards of three-quarters of a mile, in perpendicular depth. To give a more complete idea of the grandeur of these geological phenomena, it should be observed, that the bottoms of these fissures are by one-fourth only, less elevated above the level of the sea, than the passages of St. Gothard and Mount Cenis.

The valley of Icononzo, or of Pandi, is less remarkable

for its dimensions, than for the extraordinary form of its rocks, which appear as if shaped by the hand of man. Their naked and barren summits form the most picturesque contrasts with the tufts of trees and herbaceous vegetables which cover the edges of the fissure. The little torrent which has worked itself a passage through the valley of Icononzo, bears the name of Rio de la Summa Paz. It descends from the eastern chain of the Andes, which, with the kingdom of New Granada, separates the basin of the river of Madelena from the vast plains of the Meta, Guaviare, and Oronoco. This torrent, confined within a bed almost inaccessible, could not have been crossed without many difficulties, had not Nature herself formed TWO BRIDGES OF ROCKS, which are justly regarded in the country as among the objects most worthy of the attention of travellers. These NATURAL BRIDGES are on the route from Santa-Fe de Bogota to Papayan and Quito.

Icononzo is the name of an ancient village of Muyscas Indians, situated on the south side of the valley, and of which scarcely any vestage now remains, except a few scattered huts. The nearest inhabited place to this remarkable spot is the little village of Pandi, or Mercadillo, distant about a mile. The road from Santa-Fe to Fusagasuga, and thence to Pandi, is one of the most difficult and least beaten to be met with in the Cordilleras. None but those who passionately love the beauties of Nature, would fail to prefer the usual road which leads from the flat of Bogota to the banks of the Madelena, to the perilous descent from the Paramo de San-Fortunato, and the mountains of Fusagasuga, towards the Natural Bridges of Icononzo.

The deep chasm through which the torrent of Summa Paz precipitates itself, occupies the centre of the valley of Icononzo. Near the first natural bridge, it maintains, for a length of nearly four-fifths of a mile, a direction from east to west. The river forms two fine cascades, the one at the spot where it enters the chasm on the west of Doa, and the other at that where it leaves it, in descending towards Melgar. It is possible that this chasm, which resembles, but on an enormous scale, the gallery of a mine, may have been the result of an earthquake, and that, at its formation, the compact bed of quartz, composing the



No. 36.—North Cape at Midnight.



No. 37.—Ice Islands and Continent of Ice in the North Polar Circle.

water. Their plumage is uniformly of a brown grey colour; and M. Humboldt, from whose account these particulars are extracted, was assured by the Indians, that these hitherto undescribed birds are of the size of a chicken, with the eyes of an owl, and a curved beak. On account of the depth of the valley, it was impossible to obtain a near view of them.

The elevation of the bridges of Icononzo—these surprising productions of nature—above the level of the ocean, is two thousand seven hundred feet, somewhat more than half a mile. In concluding his description of them, M. Humboldt noticed several other natural bridges, among which is that of Cedar-creek, in Virginia. It is an arch of limestone, having an aperture of ninety feet, and an elevation of two hundred and twenty feet above the level of the water of the creek. He considers this, as well as the bridge of earth, called Rumichaca, which is on the declivity of the porphyritic mountains of Chumban, in the South American province of Los Pastos; together with the bridge of Madre de Dios, named Dantcu, near Totonilco, in Mexico; and the perforated rock near Grandola, in the province of Alentejo, in Portugal, as geological phenomena, which have some resemblance to the natural bridges of Icononzo; but he doubts whether, in any other part of the world, there has yet been discovered an accidental arrangement so extraordinary as that of three masses of rock, which, reciprocally sustaining each other, form a natural arch.

ROCK BRIDGE IN VIRGINIA.

[*See Plate, No.* 35.]

This Natural Bridge is described by Mr. Jefferson, late President of the United States, as one of the most sublime of the productions of nature. It is on the ascent of a hill, which seems to have been cloven through its length by some great convulsion. It is in height two hundred and thirteen feet, about fifty feet in breadth at the bottom, and at the superior part about ninety feet. The passage over it is about sixty feet in width, and the thickness of the mass at the summit of the arch about forty feet. A portion of this thickness is constituted by a coat of earth, which affords growth to many large trees. The residue,

with the hill on both sides, is a solid rock of lime-stone. The arch approaches the the semi-elliptical form; but the larger axis of the ellipsis, which would be the cord of the arch, is many times longer than its transverse. Although the sides of this bridge are provided in some parts with a parapet of fixed rocks, yet few persons have sufficient resolution to walk to them, and look over into the abyss. The passenger involuntarily falls on his hands, creeps to the parapet, and peeps over it. Looking down from this height, for the space of a minute, occasions a violent headache. If the view from above be so exquisitely painful as not long to be borne, that from beneath is delightful in the extreme. It is impossible for the emotions arising from the sublime to be felt in a greater degree than at this spot. The rapture of the spectator cannot be described, when he surveys an arch at once so beautiful, so elevated, and so light, springing up, as it were, to heaven!

This grand natural bridge is in the county of Rockbridge, to which it has given name, and affords a public and commodious passage over a valley, which cannot be crossed elsewhere for a considerable distance.

PRECIPICES AND PROMONTORIES.

BESSELY GAUT.

The precipitous pathways which frequently occur in the Indian Appennines, a chain of mountains extending along the Western or Malabar Coasts of the Peninsula, are called Gauts; and of these abrupt and perpendicular precipices, Bessely Gaut is considered as the most romantic. It is admirably described in the travels of Lord Valentia, from which the following particulars are extracted.

On entering the defiles of the chain of mountains by which the table-land of Mysore is separated from the low country of Canara and Malabar, the scenery becomes extremely wild and romantic. Having reached Purneah Chuttoor, situated on the summit of this celebrated Gaut, his lordship began his descent at three in the morning, by a road formed with great labour out of a bed of loose rock, over which the torrents of the preceding winter had

run with such force, as to wash away all the softer parts, and in several places to leave single rocks, of four or five feet diameter, standing in the centre of the road, and not more than two feet asunder. He alighted from his palanquin to admire the sublimity of the scene, and entered a forest of the largest Oriental trees, several of which were one hundred feet in the stem before a single branch extended itself, notwithstanding which, the descent was so steep, that he was frequently on a level with their tops, at so small a distance as to be able to distinguish them, by the gleam of the numerous torches by which his party was accompanied, but which were insufficient to enlighten the impenetrable canopy of foliage which for miles concealed the face of heaven, or the deep gloom of the abyss into which he appeared to descend. In the day time the scene could not have been half so awful or magnificent. The descent was impeded by numerous droves of oxen which were ascending the Gaut.

At break of day an opening, in a winding part of the road, displayed the lofty mountain the party had descended, covered with forests nearly to its summit. They passed several rivulets, which at one spot had united, and formed a small stream. The surrounding vegetation was richly variegated; and the branches of the loftiest trees covered by plants of the parasitical tribe. The inhabitants of a small village, in the centre of this immense forest, were employed in thrashing their grain in a truly patriarchal manner: on a floor of hard earth the grain was trodden out by oxen, which agreeably to the Mosaical law, were unmuzzled.

THE CAPE OF THE WINDS.

The fortress of Mankoop, in the Crimea, is of a very extraordinary magnitude, and may be described as being literally stationed on the clouds. It covers the summit of a semicircular insulated mountain, which, from its frightful aspect, its altitude, and craggy perpendicular sides, independently of every other consideration than as a surprising work of nature, fills the mind with wonder on entering the defile. In this singular situation, where there are not any visible means of ascent towards the height, and still less

of conveying the necessary materials for the completion of so astonishing a work, the Genoese constructed this citadel, perhaps without a parallel in Europe, the result of their wealth, address, and enterprise. Being at a remote distance from the coast, it is natural to conjecture that it was employed to curb the hostile spirit of the natives towards the maritime colonial possessions. The latest possessors of this fortress were Jews, in the cemetery of whose colony the traveller meets with ruined tombs of marble and stone, lying beneath the trees he has to pass in his ascent.

The whole of the passage up the mountain is steep and difficult; nor is it rendered more practicable by the amazing labours of its original possessors, whose dilapidated works occur almost at every step. On reaching the summit, caverns and gloomy galleries, perforated in the rock, present on every side their dark mouths. On the most elevated part of this extraordinary eminence, is a beautiful plain, covered with fine turf; it is partly fenced in by the mouldering wall of the fortress, but otherwise open to the surrounding precipices. From this spot the adjacent mountains, valleys, hills, woods, and villages, may be discerned. "While," observes the traveller, by whom these details are supplied, "with dismay and caution we crept on our hands and knees to look over the brink of these fearful heights, a half-clad Tartar, wild as the winds of the north, mounted without a saddle, and without any other bridle except the twisted stem of a wild vine, on a colt equally unsubdued, galloped to the very edge of the precipice, where, as his horse stood prancing on the borders of eternity, he amused himself with pointing out to us the different places in the vast district which the eye commanded. We entered one of the excavated chambers,—a small square apartment, which led to another on our right-hand; and, on our left, a narrow passage conducted us to an open balcony, with a parapet in front, formed of the rock, on the very face of one of the principal precipices, whence the depth below might be contemplated with less danger. The vultures which hovered over the valleys did not appear larger than swallows; and the tops of the hills, covered by tufted woods, with the villages scattered amid the rocks and defiles, appeared at so intimidating a depth, that the blood chilled at the view. At

length, being conducted to the north-eastern point of the crescent, that being the shape of the summit on which the fortress of Mankoop was built, and descending a few stone steps, neatly hewn out in the rock, we entered by a square door the cavern, called by the Tartars THE CAPE OF THE WINDS. It has been chisseled, like the rest, out of the solid stone; but is open on four sides. From the amazing prospect here commanded of all the surrounding country, it probably served as a post of military observation. The apertures, or windows, are large arched chasms in the rock: through these, a most extensive range of scenery over the distant mountains and rolling clouds forms a sublime spectacle. There is nothing in any part of Europe to surpass the tremendous grandeur of the place. Beneath the cavern is another chamber leading to the several cells on its different sides; these have all been cut out of the same rock."

The party, in descending, pursued a different route, which, if they had taken in their ascent, would, our traveller observes, have afforded them a view of the sublimest scenery imaginable. They now passed beneath an old arched gate-way of the citadel, once its principal entrance. This road flanks the northern side of the mountain; and the fall into the valley is so bold and profound, that a single false step would precipitate both horse and rider. By alighting, the danger is avoided; and the terror of the descent compensated by the noblest scenery the eye ever beheld. It was dark before they reached the bottom; and they had some difficulty to regain the principal road which leads through the defile, owing principally to the trees which project over all the lanes in the vicinity of Tartar villages, and so effectually obstruct the passage of persons on horseback, that they were in continual danger of being thrown. The defile itself is not without danger in certain seasons of the year, immense masses of limestones detaching themselves from the rocks above, and carrying all before them in their descent. Several of these masses, detached from the northern precipices, had crossed the river at the bottom, and, by the prodigious velocity acquired in their descent, had actually rolled nearly half-way up the opposite side.

THE NORTH CAPE.

[*See Plate, No. 36.*]

THIS Cape forms the most northerly point of the Continent of Europe, and may be regarded as one of the sublimest wonders of nature. It is situated within the arctic circle, in seventy-one degrees ten minutes north latitude. It has been accurately described by a late voyager, from whose account the following particulars are extracted.

In approaching the Cape, a little before midnight, its rocks at first appeared to be nearly of an equal height, until they terminated in a perpendicular peak; but, on a nearer view, those within were found to be much higher than those of the extreme peak, or point. Their general appearance was highly picturesque. The sea, breaking against this immovable rampart, which had withstood its fury from the remotest ages, bellowed, and formed a thick border of white froth. This spectacle, equally beautiful and terrific, was illumined by the MIDNIGHT SUN; and the shade which covered the western side of the rocks rendered their aspect still more tremendous. The height of these rocks could not be ascertained; but here every thing was on so grand a scale, that a point of comparison could not be afforded by any ordinary known objects.

On landing, the party discovered a grotto, formed of rocks, the surface of which had been washed smooth by the waves, and having within a spring of fresh water. The only accessible spot in the vicinity was a hill, some hundred paces in circumference, surrounded by enormous crags.—From the summit of this hill, turning towards the sea, they perceived to the right a prodigious mountain, attached to the Cape, and rearing its sterile mass to the skies. To the left, a neck of land, covered with less elevated rocks, against which the surges dashed with violence, closed the bay, and admitted but a limited view of the ocean. To see as far as possible into the interior, our navigators climbed almost to the summit of the mountain, where a most singular landscape presented itself to the view. A lake in the foreground had an elevation of at least ninety feet above the level of the sea; and on the top of an adjacent, but less lofty mountain, was another lake. The

view was terminated by peaked rocks, chequered by patches of snow.

At midnight the sun still remained several degrees above the horizon, and continued to ascend higher and higher till noon, when having again descended, it passed the north, without dipping below the horizon. This phenomenon, which is as extraordinary to the inhabitants of the torrid and temperate zones, as snow is to the inhabitants of the torrid zone, could not be viewed without a particular interest. Two months of continued day-light, during which space the sun never sets, seem to place the traveller in a new state of existence; while the effect on the inhabitants of these regions is singular. During the time the sun is perpetually above the horizon, they rise at ten in the morning, dine at five or six in the evening, and go to bed at one. But, during the winter season, when, from the beginning of December until the end of January, the sun never rises, they sleep above half of the twenty-four hours, and employ the other half in sitting over the fire, all business being at an end, and a constant darkness prevailing.

The cause of this phenomenon, as it affects the northern and southern regions of the earth, may be readily understood. The sun always illumines half the earth at once, and shines on every side ninety degrees from the place where he is vertical. When he is vertical over the equator, or equidistant from both poles, he shines as far as each pole; and this happens in spring and autumn. But, as he declines to the north in summer, he shines beyond the north pole, and all the countries near that pole turn round in perpetual sunshine: he, at the same time, leaves the south pole an equal number of degrees, and those parts turn round in darkness. The effect is contrary at each pole in our winter, the sun then declining southward of the equator.

About three miles from the North Cape lies Maso, the northernmost port of Norwegian Lapland. It is formed of a very fine bay, in which ships may winter with the greatest security.

PRECIPICES OF SAN ANTONIA.

The mountain of San Antonia, on the route from Guayaquil to Quito, is described by Ulloa as presenting a series of the most fearful precipices. In crossing this mountain, the declivity was in some parts so great, that the mules could not have kept their footing, had not the paths been filled with holes, upwards of two feet in depth, in which the mules placed their fore and hinder feet, occasionally dragging their bellies, and the legs of the rider, along the ground. Without these holes which serve as steps, the precipice would not be practicable. Should the creature happen, however, to place his foot between two of these holes, or to faulter in the slightest degree, the rider would fall, and perish inevitably. To lessen the difficulties and dangers of these craggy paths, the Indians who go before the travellers, dig small trenches across.

The descent from the heights was a task of imminent danger. Owing to the excessive steepness, the water had washed away a greater part of the holes; while, on the one side were steep eminences, and on the other, the most frightful abysses. The mules were themselves sensible of the caution requisite in descending; for, on reaching the top of an eminence, they stopped, and having placed their fore feet close together, as in a posture of stopping themselves, they also placed their hinder feet together but a little forwards, as if going to lie down. In this attitude, having, as it were, taken a survey of the road, they slid down with the swiftness of a meteor. All the rider had to do, was to keep himself fast in his saddle, without checking his beast; as the least motion would have been sufficient to destroy its equilibrium, and both would have inevitably perished. The address of the creatures was truly wonderful, for, in this rapid motion, when they seemed to have lost all government of themselves, they followed exactly the different windings of the road, as if they had previously reconnoitered, and settled in their minds the route they were to follow, and taken every precaution for their safety, amid so many irregularities. The safety of the rider depended entirely on their experience and address;

but, long as they had been accustomed to travel these roads, they still felt a degree of horror on reaching the top of a steep declivity. Without being checked by their rider, they stopped; and if he inadvertantly endeavoured to spur them on, they were immovable until they had placed themselves in a secure posture. They seemed truly to be actuated by reason; for they not only viewed the road attentively, but trembled and snorted at the danger—emotions which inspired the party with the most dreadful apprehensions. The Indians went before, and, placing themselves along the sides of the mountain, where they held by the roots of trees, animated the beasts with shouts, until they at once started down the declivity.

There were some parts where the declivities were not on the side of the precipices; but the road was so narrow and hollow, and the sides nearly perpendicular, that the danger was almost equal. The track being extremely narrow, with scarcely a sufficent width of the road to admit the mule with its rider, if the former had fallen, the latter would necessarily have been crushed, and, for want of room to disengage himself, would have been mutilated in his limbs, if he had escaped with life. It was truly wonderful to consider with what exactness these animals, after having overcome the first emotions of their fear, and when they were going to slide down the declivity, stretched out their fore-legs, to the end that they might preserve their equilibrium. The gentle inclination they made with the body, at a proper distance, in following the several windings of the road, was also a mark of surprising sagacity; and, lastly, their address in stopping themselves at the end of the impetuous career, was truly deserving of observation. Greater prudence and conduct could not have been exhibited by man!

PRECIPICE OF THE TABLE MOUNTAIN, SOUTH CAROLINA.

The Table Mountain, situated in Pendleton District, in South Carolina, presents an awful precipice of nine hundred feet. Few persons who have once cast a glimpse into the almost boundless abyss beneath, can again exercise sufficient fortitude to approach the margin of the chasm.

Almost every one, on looking over, involuntarily falls to the ground, senseless, nerveless, and helpless; and would inevitably be precipitated, and dashed to atoms, were it not for measures of caution and security, that have always been deemed indispensable to a safe indulgence of the curiosity of the visitor or spectator. Every one, on proceeding to the spot, whence it is usual to gaze over the wonderful deep, has, in his imagination, a limit or bound, graduated by a reference to distances with which his eye has been familiar. But in a moment, eternity, as it were, is presented to his astonished senses; and he is instantly overwhelmed: his whole system is no longer subject to his volition or his reason, and he falls like a mass of lead, obedient only to the common laws of mere matter. He then revives, and in wild delirium, surveys a scene which, for a while, he is unable to define by description or limitation.

GEOLOGICAL CHANGES OF THE EARTH.

There are more things in heaven and earth
Than are dreamt of in our philosophy.

SHAKESPEARE.

THE variety of fossil substances, many of them marine productions, which are found in mountains remote from the sea, are undeniable proofs that the earth's surface has undergone considerable changes, some of which indicate an alteration of climate not easily to be explained. The remains of animals inhabiting hot countries, and the marine productions of hot climates, which are frequently found in high northern latitudes, lead to a suspicion that the earth's axis was at a very remote period differently inclined to what it is at present. The tropics now extend twenty-three degrees and a half on each side the equator; but if they were extended to forty five degrees, then the arctic circle and the tropics would coincide, and thence would arise inconceivable variations in the productions and phenomena of the earth. All this would form an amusing speculation to a person possessed of a terrestrial globe, who might tie a thread round it to represent the tropics at forty-five degrees of elevation.

By the gradual operation of the sea, and of rivers, the face of the globe has, in the course of ages, undergone very material changes. The former has encroached in particular parts, and retired from others; and the mouths of large rivers, running through low countries, have often been variously modified, by a deposition and transfer of the matter washed down from the land. At Havre, the sea undermines the steep coast; while it recedes at Dunkirk, where the shore is flat. In Holland the Zuyder Zee was probably formed, in the middle ages, by continual irruptions of the sea, where only the small lake Flevo had before existed. The mouths of the Rhine have been considerably altered, as well in their dimensions as in their directions. The mud, as it is deposited by large rivers, generally causes a *delta*, or a triangular piece of land, to grow out into the sea. Thus the mouth of the Mississippi is said to have advanced above fifty miles since the discovery of America. The island called Sandy Hook, at the entrance of the river of New York, was about forty years ago, a peninsula attached to the high land. The sea, within the space of forty years, has retired more than a mile from Rosetta, in Egypt; and the mouths of the Arno, and of the Rhone, consist in a great measure of new land.

The Javanese have a tradition, that in former times the Islands of Sumatra, Java, Bali, and Sumbawa, were united, and afterwards separated into nine different parts. They add, that when three thousand rainy seasons shall have passed away, they will be united. In the Mediterranean, geological phenomena evince, that the Island of Malta, and that of Gozo, its dependency, now separated by a wide channel, and the intermediate small Island of Cumino, formed, together with the latter, a single island. By the encroachments of the sea, and the subsidence of some parts of the land, the islands of Scilly, the aboriginal inhabitants of which carried on a considerable trade in tin with the Phenicians, Greeks, and Romans, are now little more than barren rocks, with small patches of earth interspersed in the hollows. Strabo describes the Phenicians as having been so jealous of their lucrative traffic with these islands, that they ran a vessel purposely on shore, and risked the lives of the crew, rather than have it made

known to the Romans. The land, within which these tin-mines were worked, must now be sunk, and buried beneath the sea. On the shifting of the sands between the islands, walls and ruins are frequently seen; the difference of level, since these walls, or fences were made, to prevent the encroachments of the sea, being estimated at sixteen feet. There is little doubt but that there must have been a subsidence of the land, followed by a sudden inundation. This, indeed, seems to be confirmed by tradition, there being a strong persuasion in the western parts of Cornwall, that there formerly existed a large country between the Land's-end and the islands of Scilly, now laid many fathoms under water. Although there are not any positive evidences of such an ancient connexion between the main land and these islands, still it is extremely probable, that the cause of the inundation which destroyed the greater part of them, may have reached the Cornish shores, there being several proofs of a subsidence of the land in Mount's Bay. The principal anchoring place, which was called a lake, is now a haven, or open harbour; and the mount, from its Cornish name, signifying *the grey rock in a wood*, must have formerly stood in a wood, but is now at full tide half a mile in the sea.

Examples of a similar kind, relative to every known country, might be multiplied. One of the most considerable inundations to be met with in history, is that which happened in the reign of Henry I. and which overflowed the estates of Earl Goodwin, forming the banks called the Goodwin Sands. In the year 1546, a similar irruption of the sea destroyed a hundred thousand persons in the territory of Dort, in the United Provinces; and a still greater number round Dollart. In Friezland and Zealand more than three hundred villages were overwhelmed; and their remains are still visible, on a clear day, at the bottom of the water. The Baltic Sea has, by slow degrees, covered a large part of Pomerania; and, among others, overwhelmed the famous port of Vineta. The Norwegian Sea has formed several little islands from the main land, and still daily advances on the continent. The German Sea has advanced on the shores of Holland, near Catt, to such a degree, that the ruins of an ancient citadel of the Romans, formerly built on that coast, are now under water.

The country surrounding the Isle of Ely was, in the time of Bede, about a thousand years ago, one of the most delightful and highly cultivated spots in Great Britain: it was overwhelmed, and remained for several centuries under water, until at length, the sea, by a caprice similar to the one which had prompted its invasions, abandoned the earth, but without the latter being able to recover its primitive state, that of one of the most fertile valleys in the world.

On the other hand, the sea has in many instances, deserted the land; and by the deposition of its sediment in some places, and the accumulation of its sands in others, has also formed new lands. In this manner the Isle of Oxney, near Romney Marsh, was produced. In France, the town of Aigues Mortes, which was a sea-port in the time of St. Louis, is now removed more than four miles from the sea. Psalmodi, also in that kingdom, was an island in the year 815, and is now upwards of six miles within the land. In Italy, a considerable portion of land has been gained at the mouth of the river Arno; and Ravenna, which once stood by the sea-side, is now considerably removed from it. Every part of Holland seems to be a conquest from the sea, and to have been rescued, in a manner, from its bosom. The industry of man, however, in the formation of dykes, is here to be brought into account; for the surface of the earth, in that country, is for the greater part below the surface of the sea.

Three-fifths of the surface of the globe are covered by the sea, the average depth of which has been estimated at from five to ten miles. Demonstrative proofs exist in Great Britian, and in various parts of the world, that great changes have taken place in the relative positions of the present continents with the ocean, which, in former ages, rolled its waves over the summits of our present elevated mountains. To illustrate this subject, and before these proofs are entered on, in the consideration of the geological phenomena, named "EXTRANEOUS FOSSILS," it will be proper to introduce the pleasing and truly philosophical view of the successive changes the earth has undergone, contained in Sir Richard Philip's Morning's Walk to Kew. In passing near the banks of the Thames, Sir Richard was led, in two several places, to introduce the

following observations and reflections on this highly curious and interesting subject. They apply the principles in a way to which they may be applied to any river, and indicate how much we are daily surrounded by the wonders of creation, the process of which, as Sir Richard observes, is *never ceasing*. In passing over the alluvial flat of Barnes Common, he introduces the following paragraphs, p. 197.——

"On this Common, nature still appears to be in a primeval and unfinished state. The entire flat from the high ground to the Thames, is evidently a mere fresh-water formation, of comparatively modern date, created out of the rocky ruins which the rains, in a series of ages, have washed from the high grounds, and further augmented by the decay of local vegetation. The adjacent high lands, being elevated above the action of the fresh water, were no doubt marine formations, created by the flowing of the sea during the four thousand years when the earth was last in its perihelion during our summer months; which was between twelve and seven thousand years since. The flat, or fresh-water formation, on which I was walking, still only approaches its completion; and the desiccated soil has not yet fully defined the boundaries of the river. At spring-tides, particularly when the line of the moon's apsides coincides with the syzygies, or when the ascending node is in the vernal equinox, or after heavy rains, the river still overflows its banks, and indicates its originally extended scite under ordinary circumstances.

"The state of transition also appears in marshes, bogs, and ponds, which, but for the interference of man, would, many ages ago, have been filled up with decayed forests and the remains of undisturbed vegetation. Rivers thus become agents of the NEVER-CEASING CREATION, and a means of giving greater equality to the face of the land. The sea as it retired, either abruptly from some situations, or gradually from others, left dry land, consisting of downs and swelling hills, disposed in all the variety which would be consequential on a succession of floods and ebbs during several thousand years. These downs, acted upon by rain, were mechanically, or in solution, carried off by the water to the lowest levels, the elevations being thereby depressed, and the valleys proportionally raised. The low lands be-

came of course the channels through which the rains returned to the sea, and the successive deposits on their sides, hardened by the wind and sun, have in five or six thousand years, created such tracts of alluvial soil, as those which now present themselves in contiguity with most rivers. The soil, thus assembled and compounded, is similar in its nature to the rocks and hills whence it was washed; but, having been so pulverized, and so divided by solution, it forms the finest medium for the secretion of all vegetable principles, and hence the banks of the rivers are the favourite residences of man. Should the channel constantly narrow itself more and more, till it becomes choaked in its course, or at its outlet, then, for a time, lakes would be formed, which, in like manner, would narrow themselves and disappear. New channels would then be formed, or the rain would so diffuse itself over the surface, that the fall and the evaporation would balance each other.

"Such are the unceasing works of CREATION, constantly taking place on this exterior surface of the earth; where, though less evident to the senses and experience of man, matter apparently inert is in as progressive a state of change, from the operation of unceasing and immutable causes, as in the visible generations of the animal and vegetable kingdoms. Thus water, wind, and heat, the energies of which NEVER CEASE to be exerted, are constantly producing new combinations, changes, and creations; which, if they accord with the harmony of the whole, are fit and "good;" but, if discordant are speedily re-organized or extinguished by contrary and opposing powers. In a word, WHATEVER IS, IS FIT; AND WHATEVER IS NOT FIT, IS NOT, OR SOON CEASES TO BE!—Such seems to be the governing principle of Nature—the key of all her mysteries—the primary law of creation! All things are the proximate effects of a balance of immutable powers—those powers are results of A PRIMORDIAL CAUSE,—while that CAUSE is inscrutable and incomprehensible to creatures possessing but a relative being, who live only in TIME and SPACE, and who feel and act merely by the IMPULSE of limited senses and powers."

Again, in page 354, Sir Richard introduces the following appesite remarks on this very interesting subject:—

"As I approached a sequestered mansion-house, and some other buildings, which together bear the name of BRICK-STABLES, I crossed a corner of the meadow towards an angle formed by a rude inlet of the Thames, which was running smoothly towards the sea, at the pace of four miles an hour. The tide unites here with the ordinary current, and running a few miles above this place, exhibits twice a day the finely-reduced edge of that physical balance-wheel, or oscillating fluid-pendulum, which creates the earth's centrifugal power, and varies the centre of its forces. In viewing the beautiful process of Nature, presented by a majestic river, we cease to wonder that priestcraft has often succeeded in teaching nations to consider rivers of divine origin, and as proximate living emblems of Omnipotence. Ignorance, *whose constant error is to look only to the last term of every series of causes*, and which charges Impiety on all who venture to ascend one term higher, and Atheism on all who dare to explore several terms, *(though every series implies a first term)* would easily be persuaded by a crafty priesthood to consider a beneficent river as a tangible branch of the Godhead. But we now know that the waters which flow down a river, are but a portion of the rains and snows which, having fallen near its source, are returning to the ocean, there to rise again and re-perform the same circle of vapours, clouds, rains, and rivers. What a process of fertilization, and how still more luxuriant would have been this vicinity, if man had not levelled the trees, and carried away the crops of vegetation. What a place of shelter would thus have been afforded to tribes of amphibiæ, whose accumulated remains often surprise geologists, though necessarily consequent on the fall of crops of vegetation on each other, near undisturbed banks of rivers. Happily, in Britain, our coal-pits, or mineralized forests, have supplied the place of our living woods; or man, regardless of the fitness of all the parts to the perfection of every natural result, might here, as in other long-peopled countries, ignorantly have thwarted the course of Nature by cutting down the timber, which, acting on the electricity of the clouds, affects their destiny, and causes them to fall in fertilizing showers. Such has been the fate of all the countries famous in antiquity. Persia, Syria, Arabia, parts of Turkey, and the

Barbary coast, have been rendered arid deserts by this inadvertency. The clouds from the Western Ocean would long since have passed over England without disturbance from the conducting power of leaves of trees, or blades of grass, if our coal-works had not saved our natural conductors; while this Thames, the agent of so much abundance and of so much wealth, might, in that case, become a shallow brook, like the once equally famed Jordan, Granicus, or Ilyssus.——

"I now descended towards a rude space near the river, which appeared to be in the state in which the occasional overflowings and gradual retrocession of the river had left it. It was one of those wastes which the lord of the manor had not yet enabled some industrious cultivator to disguise; and in large tracts of which Great Britain still exhibits the surface of the earth in the pristine state in which it was left by the secondary causes that have given it form. The Thames, doubtless, in a remote age, covered the entire site; but it is the tendency of rivers to narrow themselves, by promoting prolific vegetable creations on their consequently increasing and encroaching banks, though the various degrees of fall produce every variety of currents, and, consequently, every variety of banks, in their devious course. In due time, the course of the river becomes choaked where a flat succeeds a rapid, and the detained waters then form lakes in the interior. These lakes likewise generate encroaching banks, which finally fill up their basins, when new rivers are formed on higher levels. These in their turn, become interrupted, and repetitions of the former circle of causes produce one class of those elevations of land above the level of the sea, which have so much puzzled geologists. The only condition which a surface of dry land requires to increase and raise itself, is the absence of salt water, consequent on which is an accumulation of vegetable and animal remains.

"The Thames has not latterly been allowed to produce its natural effects, because for two thousand years the banks have been inhabited by man, who unable to appreciate the general laws by which the phenomena of the earth are produced, has sedulously kept open the course of the river, and prevented the formation of interior lakes. The Cas-

pian sea, and all similar inland seas and lakes, were, for the most part, formed from the choaking up of rivers, which once constituted their outlets. If the course of nature be not interrupted by the misdirected industry of man, the gradual desiccation of all such collections of water will, in due time, produce land of higher levels on their sites. In like manner, the great lakes of north America, if the St. Lawrence be not sedulously kept open, will in the course of ages, be filled up by the gradual encroachment of their banks, and the raising of their bottoms with strata of vegetable and animal remains.—New rivers would then flow over these increased elevations, and the ultimate effect would be to raise that part of the Continent of North America several hundred feet above its present level. Even the very place on which I stand was, according to WEBSTER, once a vast basin, extending from the Nore to near Reading, but now filled up with vegetable and animal remains; and the illustrious CUVIER has discovered a similar basin round the site of Paris. These once were Caspians, created by the choaking and final disappearance of some mighty rivers—they have been filled up by gradual encroachments, and now the Thames and the Seine flow over them;—but these, if left to themselves, will, in their turn, generate new lakes or basins—and the successive recurrence of a similar series of causes will continue to produce similar effects, till interrupted by *superior* causes.

"This situation was so sequestered, and therefore so favourable to contemplation, that I could not avoid indulging myself. What, then, are those superior causes, I exclaimed, which will interrupt this series of natural operations to which man is indebted for the enchanting visions of hill and dale, and for the elysium of beauty and plenty in which he finds himself? Alas! facts prove, however, that all things are transitory, and that change of condition is the constant and necessary result of that notion which is the chief instrument of eternal causation, but which, in causing all phenomena, wears out existing organizations while it is generating new ones. In the motions of the earth as a planet, doubtless are to be discovered the superior causes which convert seas into continents, and continents into seas. These sublime changes are occasioned by

the progress of the perhelion point of the earth's orbit through the ecliptic, which passes from extreme northern to extreme southern declination, and *vice versa*, every ten thousand four hundred and fifty years; and the maxima of the central forces in the perhelion occasion the waters to accumulate alternately upon either hemisphere. During ten thousand four hundred and fifty years, the sea is therefore gradually retiring and encroaching in both hemispheres:—hence all the varieties of marine appearances and accumulations of marine remains in particular situations; and hence the succession of layers or strata, one upon another, of marine and earthly remains. It is evident, from observation of those strata, that the periodical changes have occurred at least three times; or in other words, it appears that the site on which I now stand has been three times covered by the ocean, and three times has afforded an asylum for vegetables and animals! How sublime—how interesting—how affecting is such a contemplation! How transitory, therefore, must be the local arrangements of man, and how puerile the study of the science miscalled Antiquities! How foolish the pride which vaunts itself on splendid buildings and costly mausoleums! How vain the ostentation of large estates, of extensive boundaries, and of great empires!—All—all will, in due time, be swept away and defaced by the unsparing ocean; and, if recorded in the frail memorials of human science, will be spoken of like the lost Atalantis, and remembered only as a philosophical dream!—*Phillips' Walk to Kew.*

EXTRANEOUS FOSSILS.

The fossil remains of animals not now in existence, entombed and preserved in solid rocks, present us with durable monuments of the great changes which our planet has undergone in former ages. We are led to a period when the waters of the ocean have covered the summits of our highest mountains, and are irresistibly compelled to admit one of two conclusions, either that the sea has retired, and sunk beneath its former level; or that some power, operating from beneath, has lifted up the islands and continents, with all their hills and mountains, from the watery abyss to their present elevation above its surface.

The calcareous, or limestone, mountains in Derbyshire,

and at Craven, in Yorkshire, having an elevation of about two thousand feet above the present level of the sea, contain, in a greater or less abundance, and throughout their whole extent, fossil remains of zoophites, shell-fish, and marine animals. Not any remains of vegetables have been found in the calcareous mountains of England; but, in the thick beds of shale and grit-stone lying upon them, are found various vegetable impressions, and above these regular beds of coal, with strata, containing shells of fresh-water muscles. In the earthy limestone of the upper strata are sometimes found fossil flat-fish, with the impression of the scales and bones quite distinct. The mountains of the Pyrenees are covered in the highest part, at Mont Perdu, with calcareous rocks, containing impressions of marine animals; and, even where the impressions are not visible in the limestone, it yields a fetid cadaverous odour, when dissolved in acids, owing, in all probability, to the animal matters it contains. Mont Perdu, which rises ten thousand five hundred feet, nearly two miles above the level of the sea, is the highest situation in which any marine remains have been found in Europe. In the Andes they have been observed by Humboldt at the height of fourteen thousand feet, more than two miles and a half. Lastly, in southern countries, in and under beds of clay-covering chalk, the bones of the elephant, and of the rhinoceros are frequently found.

These bones, as they have been brought from different parts of the world, have been examined with the utmost attention by the sagacious naturalist, Cuvier. He has observed characteristic variations of structure, which prove that they belong to animals not now existing on our globe: nor have many of the various zoophites and shell-fish, found in calcareous rocks, been discovered in our present seas. From these very curious facts he makes the following deductions.

"These bones are buried, almost every where, in nearly similar beds: they are often blended with some other animals resembling those of the present day. The beds are generally loose, either sandy or marly; and always neighbouring, more or less, to the surface. It is then probable that these bones have been enveloped by the last, or by one of the last, catastrophes of this globe. In a great

number of places they are accompanied by the accumulated remains of marine animals; but in some places, which are less numerous, there are none of these remains: sometimes the sand or marle, which covers them, contains only fresh-water shells. No well authenticated account proves that they have been covered by regular beds of stone, filled with sea-shells; and, consequently, that the sea has remained on them undisturbed, for a long period. The catastrophe which covered them was, therefore, a great, but transient, inundation of the sea. This inundation did not rise above the high mountains; for we find no analagous deposits covering the bones, nor are the bones themselves there met with, not even in the high vallies, unless in some of the warmer parts of America. These bones are neither rolled nor joined in a skeleton, but scattered, and in part fractured. They have not, then, been brought from afar by inundation, but found by it in places where it has covered them, as might be expected, if the animals to which they belonged had dwelt in these places, and had there successively died. Before this catastrophe, these animals lived, therefore, in the climates in which we now dig up their bones: it was this catastrophe which destroyed them there; and, as we no longer find them, it is evident that it has annihilated those species. The northern parts of the globe, therefore, nourished formerly species belonging to the genus *elephant*, *hippopotamus*, *rhinoceros*, and *tapir*, as well as to *mastodon*, genera of which the four first have no longer any species existing, except in the torrid zone; and of the last, none in any part."

That every part of the dry land was once covered by the ocean, is a fact on which all geologists agree; and the discovery, noticed above, of the fossil remains of many genera of quadrupeds, once existing, but which have now disappeared from the earth, leads to another fact, not less interesting, and which is at the same time coincident with the oldest records or traditions of the human race, namely, that at the period when these great changes took place, man was not an inhabitant of the planet. These fossil remains, now about to be particularized, are among the most surprising of nature's phenomena, and irresistibly lead to awful speculations respecting the past and future condition of the terrestrial globe.

FOSSIL CROCODILES.

These fossils were collected in the neighbourhood of Honfleur, on the coast of France, and were found in a bed of hard limestone, of a bluish grey colour, which becomes nearly black when wet, and which is found along the shore on both sides of the mouth of the Seine, being in some places covered by the sea, and in others, above its level, even at high water.

Remains of crocodiles have also been found in other parts of France; as, at Angers and Mans. Some of these remains seem to show, that at least one of the fossil species above noticed is also found in other parts of France besides Honfleur.

The remains of crocodiles have been also found in different parts of England; but particularly on the coast of Dorsetshire, and of Yorkshire, near Whitby; in the neighbourhood of Bath; and near Newark, in Nottinghamshire.

Somersetshire, particularly in the neighbourhood of Bath, the cliffs on the Dorsetshire, or Southern, coast, and on the Yorkshire, or Northern, coast, are the places in this island in which the remains of the animals of this tribe have been chiefly found. The matrix in which they are found is in general similar to that which has been already mentioned as containing the fossils of Honfleur—a blue limestone, becoming almost black when wetted. This description exactly agrees with the limestone of Charmouth, Lime, &c. in Dorsetshire, on the opposite coast to that of France, on which Honfleur is situated. At Whitby and Scarborough, where these fossils are also found, the stone is indeed somewhat darker than in the former places; but no difference is observable which can be regarded as offering any forcible opposition to the probability of the original identity of this stratum, which is observed on the northern coast of France, on the opposite southern English coast, and at the opposite northern extremity of the island. Some of these remains are also found in quarries of common coarse grey and whitish limestone. Instances of this kind of matrix, for these remains, are observable in the quarries between Bath and Bristol.

The Rev. Mr. Hawker, of Woodchester in Gloucestershire, possesses, perhaps, one of the handsomest specimens of the remains of the crocodile discovered in this island. It was found by him in the neighbourhood of Bath, and contains a great part of the head and of the trunk of the animal.

LARGE FOSSIL ANIMAL OF MAESTRICHT.

The large animal, whose fossil remains are found in the quarries of Maestricht, has been deservedly a frequent object of admiration; and the beautiful appearance which its remains possess, in consequence of their excellent state of preservation, in a matrix which admits of their fair display, has occasioned every specimen of this fossil to be highly valued. The lower jaw of this animal, with some other specimens, which were presented by Dr. Peter Camper to the Royal Society, and which are now in the British Museum, are among the most splendid and interesting fossils in existence.

In 1770, the workmen, having discovered part of an enormous head of an animal imbedded in the solid stone, in one of the subterraneous passages of the mountain, gave information to M. Hoffman, who, with the most zealous assiduity, laboured until he had disengaged this astonishing fossil from its matrix. But when this was done, the fruits of his labours were wrested from him by an ecclesiastic, who claimed it as being proprietor of the land over the spot on which it was found. Hoffman defended his right in a court of justice; but the influence of the Chapter was employed against him, and he was doomed not only to the loss of this inestimable fossil, but to the payment of heavy law expences. But in time, justice, M. Faujas says, though tardy, at last arrived—the troops of the French Republic secured this treasure, which was conveyed to the National Museum.

The length of the cervical, dorsal, and lumbar vertebræ, appears to have been about nine feet five inches, and that of the vertebræ of the tail about ten feet; adding to which the length of the head, which may be reckoned, considering the loss of the intermaxillary bones, at least at four feet, we may safely conclude the whole length of the skel-

eton of the animal to have approached very nearly to twenty-four feet.

The head is a sixth of the whole length of the animal; a proportion approaching very near to that of the crocodile, but differing much from that of the monitor, the head of which animal forms hardly a twelfth part of the whole length.

The tail must have been very strong, and its width, at its extremity, must have rendered it a most powerful oar, and have enabled the animal to have opposed the most agitated waters, as has been well remarked by M. Adrien Camper. From this circumstance, and from the other remains which accompany those of this animal, there can be no doubt of its having been an inhabitant of the ocean.

Taking all these circumstances into consideration, M. Cuvier concludes, and certainly on fair, if not indisputable, grounds, that this animal must have formed an intermediate genus between those animals of the lizard tribe, which have an extensive and forked tongue, which include the monitors and the common lizards, and those which have a short tongue, and the palate armed with teeth, which comprise the iguanas, marbres, and anolis. This genus, he thinks, could only have been allied to the crocodile by the general characters of the lizards.

FOSSIL REMAINS OF RUMINANTIA.

Among the fossils of the British Empire, none are more calculated to excite astonishment than the enormous stags' horns which have been dug up in different parts of Ireland. Their dimensions, Dr. Molyneux informs us, were as follows:—

	Feet.	Inch.
From the extreme tip of each horn, - - - -	10	10
From the tip of the right horn to its root, - -	5	2
From the tip of one of the inner branches to the tip of the opposite branch, - - -	3	7½
The length of one of the palms, within the branches, - - - - - - - - - - - -	2	5
The breadth of the same palm within the branches, - - - - - - - - - - - -	1	10½
The length of the right brow antler, - - - -	1	2

A similar pair, found ten foot under ground, in the county of Clare, was presented to Charles II. and placed in the horn-gallery, Hampton-Court; but was afterwards removed into the guard-room of the same palace.

At Ballyward, near Ballyshannon; at Turvey, eight miles from Dublin; and at Portumery, near the river Shannon, in the county of Galway; similar horns have been found. In the common-hall of the Bishop of Armagh's house, in Dublin, was a forehead, with two amazingly large beams of a pair of this kind of horns, which, from the magnitude of the beams, must have much exceeded in size those of which the dimensions are given above. Dr. Molyneux states, that in the last twenty years, thirty pair of these horns had been dug up by accident in this country; the observations, also, of several other persons, prove the great frequency with which these remains have been found in Ireland.

Various opinions have been entertained respecting this animal and its existing prototype. This, however, does not appear to have been yet discovered; and these remains may, therefore, be regarded as having belonged to an animal now extinct.

FOSSIL REMAINS OF ELEPHANTS.

Numerous remains of elephants have been found in Italy; and, although a very considerable number of elephants were brought from Africa into that country, yet the vast extent through which these remains have been found, and the great probability that the Italians, particularly the Romans, would have known sufficient of the value of ivory, to have prevented them from committing the tusks to the earth, lead to the belief, that by far the greater number of these remains which have been dug up, have been deposited here, not by the hands of man, but by the changes that, at least, the surface of this globe has undergone, at very remote periods. The circumstances, indeed, under which many of these have been found, afford indubitable proof of this fact.

In France, where it is well known that living elephants have been much less frequent, at least in times of which we have any record, than either in Italy or Greece, their

fossil remains have been found in a great number of places, and in situations which prove their deposition at a very remote period. The whole valley through which the Rhine passes, yields fragments of this animal, and perhaps more numerously on the side of Germany than on that of France. Not only in its course, but in the alluvia of the several streams which empty themselves into it, are these fossil remains also found. Thus Holland abounds with them, and even the most elevated parts of the Batavian Republic are not exempt from them.

Germany and Switzerland appear particularly to abound in these wonderful relics. The greater number found in these parts, is, perhaps, as is observed by M. Cuvier, not attributable to their greater abundance, but to the number of well-informed men, capable of making the necessary researches, and of reporting the interesting facts they discover.

As in the banks of the Rhine, so in those of the Danube, these fossils abound. In the valley of Altmuhl is a grand deposit of these remains. The bones which have been found at Krembs, in Sweden; at Baden, near Vienna; in Moravia; in different parts of Hungary and of Transylvania; at the foot of the Hartz; in Hesse; at Hildesheim; all appear to be referable to this animal. So also are those which are found on the Elbe, the Oder, and the Vistula. Different parts of the British Empire are not less productive of these remains.

In London, Brentford, Harwich, Norwich, Gloucestershire, Staffordshire, Warwickshire, Salisbury, the Isle of Shepey, and, indeed, in several other parts of Great Britain, different remains of these animals have been found.

When we add to those places which have been already enumerated, Scandinavia, Ostrobothnia, Norway, Iceland, Russia, Siberia, Tunis, America, Huehuetoca, near Mexico, and Ibarra, in the province of Quito, near Peru; it will appear that there is hardly a part in the known world, whose subterranean productions are known to us, in which these animal remains have not been discovered.

M. Cuvier is satisfied, from the actual comparison of several skulls of the East-Indian and African elephants, that different specific characters exist in them respectively. In the Indian elephant, the top of the skull is raised in a

kind of double pyramid; but, in the African it is nearly rounded. In the Indian the forehead is concave, and in the African it is rather convex. Several other differences exist, not necessary to be here particularised, which seem to be fully sufficient to mark a difference of species.

A cursory view is sufficient to enable us to determine that the ordinary fossil teeth of elephants are not of the African species, and it may be further said, that the greater number of these teeth bear a close resemblance to the East-Indian species, showing, on their masticating surface, bands of an equal thickness through their whole length, and rudely crenulated. So great, indeed, is the resemblance, that Pallas, and most other writers, have considered the fossil elephant as being of the same species with the Asiatic.

M. Cuvier, anxious to discover the degree of accordance of the fossil elephant's skeleton with that of the living species, compared the fossil skull, found in Siberia by Messerschmidt, with those of the African and Asiatic elephants. The result of his comparison was, that in the fossil species the alveoli of the tusks are much longer; the zygomatic arch is of a different figure; the postorbital apophysis of the frontal bone is longer, more pointed, and more crooked; and the tubercle of the os lachrymalis is considerably larger, and more projecting. To these peculiarities of the fossil skull, M. Cuvier thinks, may be added the parallelism of the molares.

Comparing together the bones of the Asiatic and of the African elephant, he was able to discover some differences between them, as well as between those and some of the fossil bones which he possessed. These latter he found, in general, approached nearest to those of the Asiatic elphant. He concludes with supposing that the fossil remains are of a species differing more widely from the Asiatic elephant than the horse does from the ass, and therefore does not think it impossible but that it might have existed in a climate that would have destroyed the elephant of India.

It may, therefore, be assumed as certain, from the observations of M. Cuvier, that at least one species of elephants has existed, of which none are now known living; and, should the difference of structure which has been pointed out, in some of the fossil teeth, be admitted as sufficient

to designate a difference of species, it may be then said, that there exist the fossil remains of, at least, two species of elephants, which were different from those with which we are acquainted.

From the preceding observations it appears, then, that the fossil elephantine remains, notwithstanding their resemblance in some respects to the bones of the Asiatic elephant, have belonged to one or more species, different from those which are now known. This circumstance agrees with the facts of the fossil remains of the tapirs and rhinoceros, which appear to have differed materially from the living animals of the same genera. The remains of elephants obtained from Essex, Middlesex, Kent, and other parts of England, confirm the observation of Cuvier, that these remains are generally found in the looser and more superficial parts of the earth, and most frequently in the alluvia which fill the bottoms of the vallies, or which border the beds of rivers. They are generally found mingled with the other bones of quadrupeds of known genera, such as those of the rhinoceros, ox, horse, &c. and frequently, also, with the remains of marine animals.

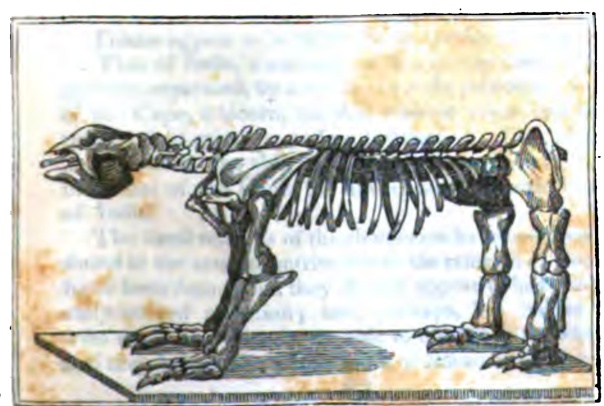
FOSSIL REMAINS OF THE MASTODON.

We now come to the examination of one of the most stupendous animals known, either in a recent or a fossil state; and which, whether we contemplate its original mode of existence, or the period at which it lived, cannot but fill our minds with astonishment.

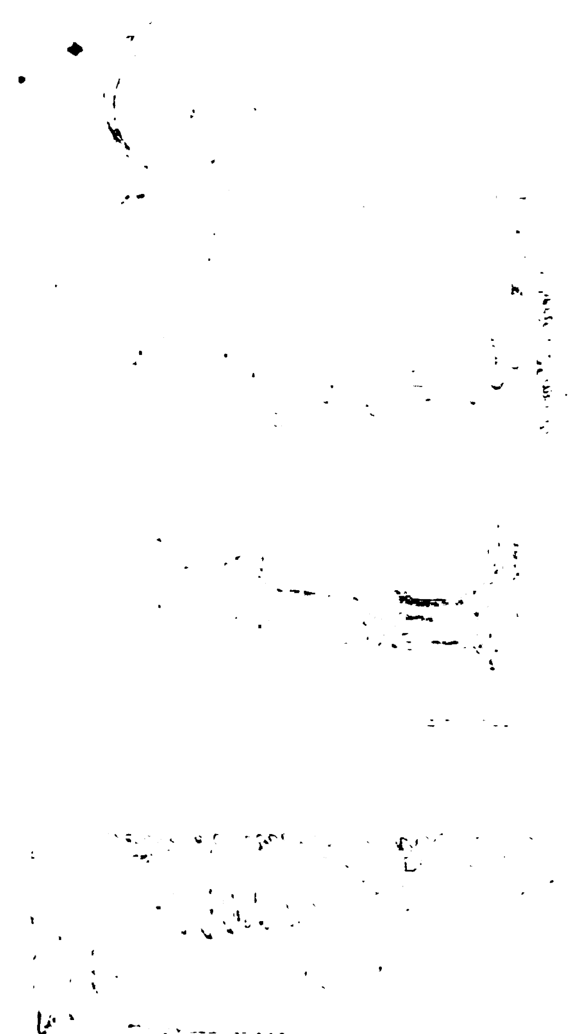
The first traces of this animal are sketched in a letter from Dr. Mather, of Boston, to Dr. Woodward, in 1712, and are transcribed from a work in manuscript, entitled *Biblia Americana.* In this work, teeth and bones of prodigious size, supposed to be human, are said to have been found in Albany, in New England. About the year 1740, numerous similar bones were found in Kentucky, on the Ohio, and dispersed among the European virtuosi.

Many bones of this animal were found, in 1799, in the State of New York, in a large plain, bounded on every side by immense mountains, in the vicinity of Newburgh, situated on the Hudson, or North River. These remains are also found on the side of the three great chains of

Siberian Mammoth.



South American Mammoth.



mountains, the Alleganies, the North Mountains, and the Blue Mountains; in the anterior parts of Pennsylvania and Carolina; and in new Jersey, a few miles from Philadelphia.

From a careful attendance to every circumstance, M. Cuvier conceives we have a right to conclude, that this great mastodon, or animal of the Ohio, did not surpass the elephant in height, but was a little longer in proportion; its limbs rather thicker; and its belly smaller. It seems to have very much resembled the elephant in its tusks, and, indeed, in the whole of its osteology; and it also appears to have had a trunk. But, notwithstanding its resemblance to the elephant, in so many particulars, the form and structure of the grinders are sufficiently different from those of the elephant, to demand its being placed in a distinct genus. From the later discoveries respecting this animal, M. Cuvier is also inclined to suppose that its food must have been similar to that of the hippopotamus and the boar, but preferring the roots and fleshy parts of vegetables; in the search of which species of food it would, of course, be led to such soft and marshy spots as it appears to have inhabited. It does not, however, appear to have been at all formed for swimming, or for living much in the waters, like the hippopotamus, but rather seems to have been entirely a terrestrial animal.

FOSSIL REMAINS OF THE RHINOCEROS.

There appear to be three living species of rhinoceros: 1. That of India, a unicorn, with a rugose coat, and with incisors, separated, by a space, from the grinders. 2. That of the Cape, a bicorn, the skin without rugæ, and having twenty-eight grinders, and no incisors. 3. That of Sumatra, a bicorn, the skin but slightly rugose, thus far resembling that of the Cape, but having incisive teeth, like that of India.

The fossil remains of the rhinoceros have been generally found in the same countries where the remains of elephants have been found; but they do not appear to have so generally excited attention; and, perhaps, but few of those who discovered them were able to determine to what animal they belonged. Thus a tooth of this animal is described

by Grew merely as the tooth of a terrestrial animal; and the remains of this animal, found in the neighbourhood of Canterbury, were supposed to have belonged to the hippopotamus.

In Hartsberg, in the principality of Grubenhagen; Quedlimburg, Darmstadt, the borders of the Rhine, Mentz, Strasbourg, the neighbourhood of Cologne, Westphalia, numerous parts of France, and in several parts of Great Britain, the remains of the rhinoceros have been found. In Siberia these remains have been met with in considerable quantities. Pallas, whose researches have been particularly directed to this part of the world, made the astonishing discovery of a complete rhinoceros, still covered by its skin, and buried in the sand on the borders of the river Wiluji.

FOSSIL REMAINS OF THE SIBERIAN MAMMOTH.

It has been demonstrated by Cuvier, that this animal was of a different species from the mastodon, or American mammoth. Its bones have been found in the alluvial soil near London, Northampton, Gloucester, Harwich, Norwich, in Salisbury plain, and in other places in England; they also occur in the north of Ireland; and in Sweden, Iceland, Russia, Poland, Germany, France, Holland, and Hungary, the bones and teeth have been met with in abundance. Its teeth have also been found in North and South America, and abundantly in Asiatic Russia. Pallas says, that from the Don to the Tchutskoiness, there is scarcely a river that does not afford the remains of the mammoth, and that they are frequently imbedded in *alluvial soil, containing marine productions*. The skeletons are seldom complete; but the following interesting narrative will show that, in one instance, the animal has been found in an entire state.

In the year 1799, a Tungusian fisherman observed a strange shapeless mass projecting from an ice-bank, near the mouth of a river in the north of Siberia, the nature of which he did not understand, and which was so high in the bank as to be beyond his reach. He next year observed the same object, which was then rather more disengaged from among the ice; but was still unable to con-

ceive what it was. Towards the end of the following summer, 1801, he could distinctly see that it was the frozen carcase of an enormous animal, the entire flank of which, and one of its tusks, had become disengaged from the ice. In consequence of the ice beginning to melt earlier, and to a greater degree than usual, in 1803, the fifth year of this discovery, the enormous carcase became entirely disengaged, and fell down from the ice-crag on a sand bank forming part of the coast of the Arctic Ocean.—In the month of March of that year, the Tungusian carried away the two tusks, which he sold for fifty rubles, about fifteen pounds sterling.

Two years afterwards this animal still remained on the sand-bank, where it had fallen from the ice; but its body was then greatly mutilated. The peasants had taken away considerable quantities of its flesh to feed their dogs; and the wild animals, particularly the white bears, had also feasted on the carcase; yet the skeleton remained quite entire, except that one of the fore legs was gone. The entire spine, the pelvis, one shoulder-blade, and three legs, were still held together by their ligaments, and by some remains of the skin; and the other shoulder-blade was found at a short distance. The head remained, covered by the dried skin, and the pupil of the eyes was still distinguishable. The brain also remained within the skull, but a good deal shrunk and dried up; and one of the ears was in excellent preservation, still retaining a tuft of strong bristly hair. The upper lip was a good deal eaten away, and the under lip was entirely gone, so that the teeth were distinctly seen. The animal was a male, and had a long mane on its neck.

The skin was extremely thick and heavy, and as much of it remained as required the exertions of ten men to carry away, which they did with considerable difficulty. More than thirty pounds weight of the hair and bristles of this animal were gathered from the wet sand-bank, having been trampled into the mud by the white bears, while devouring the carcase. The hair was of three distinct kinds; one consisting of stiff black bristles, a foot or more in length; another of thinner bristles, or coarse flexible hair, of a reddish-brown colour; and the third of coarse reddish-brown wool, which grew among the roots of the

hair. These afford an undeniable proof that this animal had belonged to a race of elephants inhabiting a cold region, with which we are unacquainted, and by no means fitted to dwell in the torrid zone. It is also evident that this enormous animal must have been frozen up by the ice at the moment of its death.

FOSSIL SHELLS.

AT whatever elevations these shells may have been found, and however remote from the parts of the globe now occupied by water, it is certain that they were once generated in the sea, by which they were deposited. The Altain chain of primitive mountains in Siberia is flanked on each side by a chain of hills inclosing marine shells. On a comparison of the forms, contexture, and composition, of these shells, as they have been found imbedded in rocks, not the slightest difference can be detected between several varieties of them and those which still inhabit the sea. At Touraine, in France, a hundred miles from the coast, and about nine feet beneath the surface, a bed of fossil shells has been found nine leagues in length, and about twenty feet in thickness. Such beds are known to exist in every part of Europe; and in South America, agreeably to Ulloa, they are very frequent.

Great Britain abounds in these fossil productions. In the cliffs of the Isle of Sheppey, bordering on the Thames, several varieties of the crab, and lobsters nearly whole, have been found in a petrified state. Within the elevated lands in the vicinity of Reading, in Berkshire, an abundance of oyster-shells have been found, many of them entire, and having both their valves united. At Broughton, in Lincolnshire, there are two quarries abounding in fresh-water shells, which are found in a blue stone, supposed to have been formerly clay, and to have been gradually indurated. A bed of shells, twelve feet thick, and lying in a greenish sand, has been found about a mile from Reculver, in Kent. At Harwich, at the entrance of the river, a sandy cliff, fifty feet in height, contains shells, of which there are no less than twenty-eight varieties. On digging a moorish pasture, in Northamptonshire, many snails and river shells were found; and these were the more abun-

dant in proportion as the workmen proceeded to a greater depth. And, lastly, the petrifactions, known by the name of *belemnites*, have been found in chalk pits, in different parts of the kingdom: they are usually cylindrical, or conical, and sometimes contain a hollow nucleus. They are supposed to constitute a species of nautilus, and very frequently occur in the coarser kinds of marble.

SUBTERRANEOUS FORESTS.

In the year 1708, a breach made by the Thames, at an extraordinary high tide, inundated the marshes of Dagenham and Havering, in Essex. Such was the impetuous rush of the water, that a large passage or channel was torn up, three hundred feet in width, and in some parts twenty feet in depth. In this way, a great number of trees, that had been buried there many ages before, were exposed to view. With one exception, that of a large oak, having the greatest part of its bark, and some of its heads and roots in a perfect state, these trees bore a greater resemblance to alder than to any other description of wood. They were black and hard, and their fibres were extremely tough. Not any doubt was entertained of their having grown on the spot where they now lay; and they were so numerous, that in many places they afforded steps to the passengers. They were imbedded in a black oozy soil, on the surface of which they lay prostrate, with a covering of grey mould.

In passing along the channel torn up by the water, vast numbers of the stumps of these subterraneous trees, remaining in the posture in which they grew, were to be seen, some with their roots running down, and others branching and spreading about in the earth, as is observed in growing trees. That they were the ruins, not of the deluge, but of a later age, has been inferred from the existence of a bed of shells, which lies across the highway, on the descent near Stifford Bridge, leading to South Okendon. At a perpendicular depth of twenty feet beneath this bed of shells, and at the distance of nearly two hundred feet, in the bottom of the valley, runs a brook which empties itself into the Thames at Purfleet. This brook is known to ebb and flow with the Thames; and, conse-

quently, if the bed of shells, as has been conjectured, was deposited in that place by an inundation of the Thames, it must have been such as to have drowned a vast proportion of the surrounding country, and have overtopped the trees near the river, in West Horrock, Dagenham, and the other marshes, overturning them in its progress. In support of this hypothesis, it should be remarked, that the bed of earth in which the trees grew, was entire and undisturbed, and consisted of a spongy, light, oozy soil, filled with the roots of reeds, of a specific gravity much less than that of the stratum above it.

The levels of Hatfield Chase were, in the reign of Charles I. the largest chase of red deer in England. They contained about one hundred and eighty thousand acres of land, about one half of which was yearly inundated; but being sold to one Vermuiden, a Dutchman, he contrived, at a great labour and expence, to dischase, drain, and reduce these lands to arable and pasture grounds not subject to be overflowed. In every part of the soil, in the bottom of the river Ouse even, and in that of the adventitious soil of all marsh land, together with the skirts of the Lincolnshire Would, vast multitudes of the roots and trunks of trees of different sizes are found. The roots are fixed in the soil, in their natural position, as thick as they could have grown; and near to them lie the trunks. Many of these trees appear to have been burned, and others to have been chopped and squared; and this in such places, and at such depths, as could never have been opened, since the destruction of the forest, until the time of the drainage. That this was the work of the Romans, who were the destroyers of all the woods and forests which are now found underground in the bottoms of moors and bogs, is evidenced by the coins and utensils, belonging to that nation which have been collected, as well in these levels, as in other parts of Great Britain where these subterraneous forests have been discovered.

MOORS, MOSSES, AND BOGS.

It having been reported in Lincolnshire, that a large extent of islets of moor, situated along its coast, and visible only at the lowest ebbs of the tide, was chiefly composed of

decayed trees, Dr. de Serra, accompanied by Sir Joseph Banks, proceeded, in the month of September, 1796, to examine their nature and extent. They landed on one of the largest of these islets, when the ebbs were at the lowest, and found its exposed surface to be about ninety feet in length, and seventy-five in width. They were enabled to ascertain, that these islets consist almost entirely of roots, trunks, branches, and leaves of trees and shrubs, intermixed with leaves of aquatic plants. The remains of many of the trees were still standing on their roots; but the trunks of the greater part of them lay scattered on the ground, in every direction. The bark of the trees and roots appeared in general as fresh as when they were growing: in that of the birches particularly, many of which were found, even the thin silvery membranes of the outer skin were discernible. The timber of all kinds, on the contrary, was decomposed and soft, in the greater part of the trees; but in some was firm, especially about the knots. Sound pieces of timber had been often found by the country people.

In general, the trunks, branches, and roots of the decayed trees were considerably flattened,—a phenomenon which has been observed in the *surtarbrand*, or fossil wood of Iceland, and also in that found near the lake of Thun, in Switzerland. The soil was chiefly composed of rotten leaves; and, on being thrown into water, many of these were taken out in a perfect state.

These islets extended about twelve miles in length, and one in breadth, opposite the shore of Sutton, at which place, on digging a well, a moor of the same nature was found under ground, at the depth of sixteen feet, and, consequently, very nearly on the same level with that which constitutes the islets. On a boring being made, in the fields belonging to the Royal Society, in the parish of Mablethorpe, to ascertain the cause of the subterraneous stratum of decayed vegetables, a similar moor was found.—The appearence of these decayed vegetables was found exactly to agree with that of the moor which is thrown up in Blankney fen, and in other parts of the east fen of Lincolnshire, in making the embankment; barks, like those of the birch-tree, being there also abundantly found. This moor has been traced as far as Peterborough, sixty

miles south of Sutton. On the north side, the moory islets extend as far as Grimsby, on the south of the mouth of the Humber: and it is a remarkable circumstance, that in the large tracts of low land which lie on the south banks of that river, a little above its mouth, there is a subterraneous stratum of decayed trees and shrubs, exactly resembling those observed at Sutton. At Axholme isle, a similar stratum extends over a tract of ten miles in length, by five in breadth. The roots there also stand in the places where they grew; while the trunks lie prostrate, amid the roots of aquatic plants and reeds.

Little doubt can be entertained of the moory islets of Sutton being a part of this extensive subterraneous stratum, which, by some inroad of the sea, has been there stripped of its covering of soil. The identity of the levels; that of the species of trees; the roots of these affixed, in both, to the soil where they grew; and, above all, the flattened shape of the trunks, branches, and roots, found in the islets, which can only be accounted for by the heavy pressure of a super-induced stratum, are sufficient reasons for this opinion. Such a wide-spread assemblage of vegetable ruins, lying almost in the same level, and that level generally under the common mark of low water, naturally gives rise to reflections on the epoch of this destruction, and the agency by which it was effected.

The original catastrophe which buried this immense forest must have been of very ancient date; but it is to be suspected, that the inroad of the sea which uncovered the decayed trees of the islets of Sutton, is comparatively recent. The state of the leaves, and the timber, and also the tradition of the country people, concur to strengthen this suspicion. Leaves and other delicate parts of plants, though they may be long preserved in a subterraneous situation, cannot remain uninjured, when exposed to the action of the waves, and of the air. The inhabitants of Sutton believe that their parish church once stood on the spot where the islets now are, and was submerged by the inroads of the sea; that, at very low water, their ancestors could even discern its ruins; and that their present church was built to supply the place of that which was washed away. So many concomitant, though weak, testimonies, render their report to a certain degree deserving of credit,

and lead to a supposition, that some of the stormy inundations of the North Sea, which in these last centuries have washed away such large tracts of land on its shores, may have carried away a soil resting on clay, and have finally uncovered the trees of these moory islets.

Bogs and Mosses are little more than lakes filled up with vegetable matter, usually of aquatic origin. They are to be found not only in Ireland and Scotland, but also in every northern country, more especially when thinly peopled. It should be remarked, that Ireland abounds in springs, which are mostly dry in summer; and that grass and weeds grow abundantly about these spots. In the winter these springs swell and run, softening and loosening all the earth about them. Now, that swerd or surface of the earth which consists of the roots of grass, being lifted up, and made fuzzy or spongy by the water in the winter, is dried in the spring, and does not fall together, but withers in a tuft. The new grass which springs through it is again lifted during the following winter; and thus the spring is still more and more stopped, and the swerd grows thicker and thicker, till at length it makes what is called a quaking bog. In proportion as it rises and becomes drier, and as the grass roots and other vegetables become more putrid, together with the mud and slime of the water, it acquires a blackness, and becomes what is called a turf bog. When the vegetables rot, it is considered that the saline particles are in general carried away by the water, in which they are dissolved; but that the oily or sulphureous particles remain and float on the water: it is thus that the turf acquires its inflammability. The highest mountains of Ireland are, as well as the plains, covered with bogs, because they abound in springs, which, on account of a defective population, are not cleared: they are thus overrun with bogs.

In that country mosses also abound; and the particular kind which grows in bogs, is remarkable on this account, that a congeries of its threads, before it is decayed, constitutes the substance of the light spongy turf, which thus becomes so tough as not to yield to the spade. This curious substance, in the North of Ireland, is called *old wives' tow*, and is not unlike flax. The turf hardens by degrees, but is still stringy when broken, and at length becomes the red turf employed as fuel.

The production of the quaking bogs is as follows:—When a stream or spring runs through a flat, it becomes filled with weeds in summer, and trees fall across and dam it up. During the winter season the water stagnates more and more every year, until the whole flat is covered. A coarse kind of grass, peculiar to these bogs, springs up in tufts, the roots of which are consolidated, and which, in a few years, grow to the height of several feet. In the winter the grass rots, and falls with its seed on the tufts, thus adding to their growth the ensuing spring. The tops of flags and grass are sometimes interwoven on the surface of the water, and gradually becoming thicker, cover its superfices. On this covering herbs grow; and by the interweaving of their roots, it is rendered so strong as to bear a man. Some of these bogs sink, where a man stands, to a considerable depth, and rise before and behind: underneath, the water is clear. Even these in time become red bogs; but may easily be converted into meadow land, by clearing a trench for the passage of the water.

Sir Hans Sloane, in his account of the bogs of Ireland, published in the Philosophical Transactions, notices a curious fact, namely, that when the turf-diggers, after having dug out the earth proper to make turf or peat, reached the bottom, so as to come to the clayey or other soil, by draining off the water, they met with the roots of fir-trees, with their stumps standing upright, and their branches spread out on every side horizontally. This was evidently the place of the growth of these trees, the branches of the roots of which are in some parts matted, as is seen in the roots of trees closely planted. Large pieces of wood have been found, not only in clay-pits, but likewise in quarries or stone-pits, in the blocks of stone raised out of their strata or layers. The black spongy mould employed for peat smells strongly of bitumen, or petroleum, a great proportion of the oil of which is yielded by distillation. In several parts of Ireland a singular phenomenon has been observed: on horses trampling with their feet on a space of soft ground, a sudden appearance of light ensued. On the mould, which agreed in colour, lightness, &c. with peat-earth, being examined with a microscope, the light was found to proceed from an abundance of small semi-transparent whitish live worms which lay in it.

The Commissioners appointed by Parliament to enquire into the nature and extent of the bogs of Ireland, and the practicability of draining them, represent them as occupying thousands of acres—indeed, many square miles. Their nature and constituent parts are described by them as consisting of an accumulation of vegetable matter, settling in successive generations on itself, and occasioned by the want of ventilation to a stagnant pool, which first furnished the elements of life and increase of the plants covering its surface. The progress of the accumulation may be best conceived by imagining a basin, or concave reservoir, of a certain extent and depth, formed of clay, limestone, gravel, or of still more abundant materials, through which the water, scantily but constantly supplied, cannot obtain an issue. Undisturbed in this water, a surface of bog moss grows, decays, and putrefies. To this a second generation succeeds; and this is followed by others, until, at length, the bulk rises considerably above the level of its bed, forming hillocks of various heights, shapes, and dimensions.—The surface of a bog is not level like a lake, but undulating; and it terminates somewhat abruptly, and almost perpendicularly. The average height of the great bogs, above the level of high water mark in Dublin harbour, is about two hundred and fifty feet. Many acres of these bogs have been reclaimed; and the practicability of draining and cultivating the greater proportion of them has been pointed out in the reports of the Commissioners.

Perthshire, in North Britain, abounds in mosses, the contents of which are computed to exceed nine thousand acres. The greatest height of the moss, above the clay on which it lies, is fourteen feet and a half. Its surface, when viewed at a distance, seems wholly covered with heath: but when closely examined, is found to be composed of small tufts of heath, intermixed with a variety of moss-plants. Here also are found innumerable trunks of trees, lying along close to their roots, the latter being still fixed in the clay, as in their natural state.

The irruption of Solway Moss has greatly attracted the public attention; for, although the cause of it is obvious, still the alteration it produced on the surface of the earth, was more considerable than any known in Great Britain, as resulting from a natural cause, since the destruc-

tion of Earl Goodwin's estate. It happened in the year 1771, after severe rains which had in many places produced great inundations of the rivers. The following is a concise description of the spot where this event happened.

Along the side of the river Esk is a vale, about a mile in breadth, bounded on the south-east by the river, and on the north-west by a steep bank, about thirty feet in height above the level of the vale. From the top of the bank the ground rises on an easy ascent for about a quarter of a mile, where it is terminated by the moss, which extends about two miles north and south, and about a mile and a half east and west, being bounded on the north-west by the river Sark. It is probable that the solid ground, from the top of the bank above the vale, was continued in the same direction under the moss, before its irruption, for a considerable space; for the moss, at the place where the irruption happened, was inclined towards the sloping ground. From the edge of the moss there was a gully or hollow, called by the country people *the gap*, and said to be thirty yards deep where it entered the vale: down this hollow ran a small rill of water, which was often dry in summer, not having any other supply but what filtered from the moss.

The irruption happened, at the head of this gap, on the night of the 16th of November, between the hours of ten and eleven, when all the neighbouring rivers and brooks were prodigiously swollen by the rains. A large body of the moss was forced, partly by the great fall of rain, and partly by the springs beneath, into a small beck or burn, which runs within a few yards of its border to the south-east. By the united pressure of the water behind it, and of this beck, which was then very high, it was carried down a narrow glen between two banks about three hundred feet high, into a wide and spacious plain, over a part of which it spread with great rapidity. The moss continued for some time to send off considerable quantities of its substance, which, being borne along by the torrent, on the back of the first great body, kept it for many hours in perpetual motion, and drove it still farther on. During the first night, at least four hundred acres of fine arable land were covered with moss from three to twelve or fifteen feet in depth. Several houses were destroyed, much

corn lost, &c; but all the inhabitants escaped. When the waters subsided, the moss also ceased to flow; but two pretty considerable streams continued to run from the heart of it, and carried away some pieces of mossy matter to the place where it burst. They then joined the beck, already mentioned, which with this addition, resumed its former channel, and with a little assistance from the people of the neighbourhood, made its way to the *Esk*, through the midst of that body of moss which obstructed its course. Thus, in a great measure drained, the new moss fell several feet, when the fair weather came on at the end of November, and settled in a firmer and more solid body on the lands it had overrun. By this inundation about eight hundred acres of arable ground were overflowed before the moss stopped, and the habitations of twenty-seven families destroyed.

Tradition has preserved the memory of a similar inundation in another part of North Britain. At Monteith a moss changed its course in one night, and covered a great extent of ground. There is also an account in the Philosophical Transactions of a moving moss near Churchtown, in Lancashire, which greatly alarmed the neighbourhood, and was regarded as a miracle. The moss was observed to rise to a surprising height, and soon after to sink as much beneath the level, moving slowly towards the south.

CORAL REEFS AND ISLANDS.

Coral belongs to the class of those surprising productions of nature, which are named *zoophites*, or plant-animals, on account of their filling up the intermediate space between the animal and vegetable kingdoms; and in treating of them this curious substance will be distinctly considered. In the mean time, the production of coral reefs and islands presents one of those geological changes, by which the earth's surface has been modified, and has received a new accession from the sea.

The common foundation of the clusters of islands discovered by modern navigators in the Pacific ocean, as well as of those belonging to New South Wales, is evidently of coral structure, immense reefs of which shoot out in all directions. There is every reason to believe that the islands which are occasionally raised by the tremendous

agency of subterraneous volcanoes, do not bear any proportion to those which are perpetually forming, by the silent but persevering efforts of the sea worms by which coral is produced. Banks of coral are found at all depths, and at all distances from the shore, entirely unconnected with the land, and detached from each other. By a quick progression, they grow up towards the surface; while the winds, heaping up the coral from deeper water, chiefly accelerate the formation of these banks into shoals and islands. They become gradually shallower; and when once the sea meets with resistance, the coral is quickly thrown up by the force of the waves breaking against the bank. These coral banks have been seen in all their stages—some in deep water—others with a few rocks appearing above the surface, just formed into islands without the least appearance of vegetation; and, lastly, others covered with soil and weeds.

The loose corals, rolled inward by the billows in large pieces, ground, and, the reflux being unable to carry them away, become a bar to the coagulated sand with which they are always intermixed. This sand, being easiest raised, is lodged at top; and when its accumulated mass is elevated by violent storms, and no longer within the reach of common waves, it becomes a resting-place to birds whom the search of prey draws thither. Their dung, feathers, &c. augment the soil, and prepare it for the reception of accidental roots, branches, and seeds, cast up by the waves, or brought thither by birds. Thus islands are formed: the leaves and rotten branches, intermixing with the sand, produce in time a light black mould, in which trees and shrubs vegetate and thrive. Cocoa nuts, which continue long in the sea without losing their vegetative powers, having been thrown on such islands, produce trees which are particularly adapted to all soils, whether sandy, rich, or rocky.

The violence of the waves, within the tropics, must generally be directed to two points, according to the monsoons. Hence the islands formed from coral banks must be long and narrow, and lie nearly in a meridional direction. Even supposing the banks to be round, as they seldom are when large, the sea meeting most resistance in the middle, must heave up the matter in greater quantities there, than

towards the extremities; and, by the same rule, the ends will generally be open, or at least lowest. They will also commonly have soundings there, as the remains of the banks, not accumulated, will be under water. Where the coral banks are not exposed to the common monsoon, they will alter their direction, and become either round, or extended in the parallel, or of irregular forms, according to accidental circumstances.

Captain Flinders, in his voyage to Terra Australis, gives a lively and interesting description of a coral reef on the southern coast of New South Wales. On this reef he landed, and the water being very clear round the edges, a new creation, as it were, but imitative of the old, was presented to the view. Wheat sheaves, mushrooms, stags' horns, cabbage leaves, and a variety of other forms, were glowing under water with vivid tints of every shade betwixt green, purple, brown, and white; equalling in beauty, and excelling in grandeur the most favourite *parterre* of the curious florist. These were different species of coral and fungus, growing, as it were, out of the solid rock, and each had its peculiar form and shade of colouring; but, whilst contemplating the richness of the scene, the destruction with which it was pregnant could not be forgotten.

Different corals in a dead state, concreted into a solid mass of a dull-white colour, composed the stone of the reef. The negro heads were lumps which stood higher than the rest; and being generally dry, were blackened by the weather; but even in these the forms of the different corals and some shells were distinguishable. The edges of the reef, but particularly on the outside where the sea broke, were the lightest parts; within these were pools and holes containing live corals, sponges, sea-eggs, and cucumbers; and many enormous cockles were scattered upon different parts of the reef. At low-water, these cockles seem most commonly to lie half open; but frequently close with much noise—and the water within the shells then spouts up in a stream, three or four feet high; it is from this noise and the spouting of the water that they are discovered, for, in other respects, they are scarcely to be distinguished from the coral rock.

His description of a coral island which he afterwards

visited on the same coast, is truly philosophical and throws great light on these surprising productions of nature.

"This little island, or rather the surrounding reef, which is three or four miles long, affords shelter from the south-east winds. It is scarcely more than a mile in circumference, but appears to be increasing both in elevation and extent. At no very distant period of time, it was one of those banks produced by the washing up of sand and broken coral, of which most reefs afford instances, and those of Torres' Strait a great many. These banks are in different stages of progress; some, like this, are become islands, but not yet habitable; some are above high-water mark, but destitute of vegetation; whilst others are overflowed with every returning tide.

"It seems to me, that, when the animalcules which form the corals at the bottom of the ocean, cease to live, their structures adhere to each other, by virtue either of the glutinous remains within, or of some property in salt water; and the interstices being gradually filled up with sand and broken pieces of coral washed by the sea, which also adhere, a mass of rock is at length formed. Future races of these animalcules erect their habitations upon the rising bank, and die in their turn, to increase, but principally to elevate, this monument of their wonderful labours. The care taken to work perpendicularly in the early stages, would mark a surprising instinct in these diminutive creatures. Their wall of coral for most part in situations where the winds are constant, being arrived at the surface, affords a shelter, to leeward of which their infant colonies may be safely sent forth, and to this their instinctive foresight it seems to be owing, that the windward side of a reef exposed to the open sea, is generally, if not always, the highest part, and rises almost perpendicular, sometimes from the depth of 200, and perhaps many more fathoms. To be constantly covered with water, seems necessary to the existence of the animalcules, for they do not work, except in holes upon the reef, beyond low-water mark; but the coral sand and other broken remnants thrown up by the sea adhere to the rock, and form a solid mass with it, as high as the common tides reach. That elevation surpassed, the future remnants, being rarely covered, lose their adhesive property; and remaining in a loose state,

form what is usually called a key upon the tops of the reef. The new bank is not long in being visited by sea birds; salt plants take root upon it, and a soil begins to be formed; a cocoa nut is thrown on shore; land birds visit it and deposit the seeds of shrubs and trees; every high tide, and still more every gale, adds something to the bank; the form of an island is gradually assumed—and last of all comes man to take possession.

"This island is well advanced in the above progressive state; having been many years, probably some ages, above the reach of the highest spring-tides, or the wash of the surf in the heaviest gales. I distinguished, however, in the rock which forms its basis, the sand, coral, and shells formerly thrown up, in a more or less perfect state of cohesion; small pieces of wood, pumice stone, and other extraneous bodies, which chance had mixed with the calcareous substances when the cohesion began, were inclosed in the rock; and, in some cases, were still separable from it without much force. The upper part of the island is a mixture of the same substances in a loose state, with a little vegetable soil; and is covered with the *casuarina* and a variety of other trees and shrubs, which give food to paroquets, pigeons, and some other birds; to whose ancestors it is probable the island was originally indebted for this vegetation."

WIDE AND INHOSPITABLE DESERTS.

ASIATIC DESERTS.

The chief Asiatic deserts are in Persia and Arabia, the former of which countries contains three of considerable extent and celebrity. The first of these commences on the east of the Tigris, in latitude thirty-three, is pervaded by the river Ahwas, and extends to the north of Shuster. The second reaches from the vicinity of Korn very nearly to the Zurra, in a line, from east to west, of about four hundred English miles, and from north to south, of about two hundred and fifty. In the latter direction it joins the great desert of Kerman, which, alone, extends over a tract of three hundred and fifty miles. The two may, therefore, be considered as forming one common desert, and stretch, north-west and south-east, over a space of about seven hundred miles, thus intersecting this wide empire into two

nearly equal portions. This vast extent is impregnated with nitre and other salts, which taint the neighbouring lakes and rivers, and has, on that account, been denominated the GREAT SALINE DESERT.

ARABIAN DESERTS.

THE SANDY DESERTS OF ARABIA form one of the most striking objects of that country. From the hills of Omon, which appear to be a continuation of those on the other side of the Persian gulf, as far as Mecca, the greater part of Negad is one prodigious desert, interrupted, towards the frontiers of Hejaz and Yemen, or Arabia Felix, by Kirge, containing the district of Sursa, and several *oases*, or fertile spots. The north-west part of Negad presents almost a continued desert, and is considered as a prolongation of the one above mentioned.

The BELED EL HARAM, or HOLY LAND OF ISLAM, of which Mecca is the capital, is comprehended between the Red Sea, and an irregular line which, commencing at Arabog, about sixty miles to the north of Djedda, forms a bend from the north-east to the south-east, in passing by Yelemlem, two days' journey to the north-east of Mecca. It thence continues to Karna, nearly seventy miles to the east of the same place, and twenty-four miles to the west of Taif, which is without the limit of the Holy Land; after which, turning to the south-west, it passes by Drataerk, and terminates at Mehherma upon the coast, at the port named Almarsa Ibrahim, about ninety miles to the south-east of Djedda.

It therefore appears that the Holy Land is about one hundred and seventy miles in length, from the north-west to the south-east, and eighty-four miles in breadth, from the north-east to the south-west—which space is comprehended in that part of Arabia, known by the name of ED HEDJEAZ, or the LAND OF PILGRIMAGE, and includes the cities of Median and Taif. It has not any river; and the only water to be found, is that of some inconsiderable springs, which are not numerous, and the brackish water obtained from the deep wells. Thus it is a REAL DESERT. It is at Mecca and Medina alone that cisterns have been wrought to preserve the rain water; on which account, a garden is very rarely to be seen throughout this

vast territory. The plains are composed either of sand, or bad earth, entirely abandoned; and, as the inhabitants do not in any part of the country, sow any description of grain, they are supplied with flour, &c. from Upper Egypt, Yemen, and India.

AFRICAN DESERTS.

THE most striking feature of AFRICA consists of the immense deserts which pervade its surface, and which are supposed to comprise the one half of its whole extent, The chief of these is, by way of eminence, called SAHARA, or the Desert. It stretches from the shores of the Atlantic, with few interruptions, to the confines of Egypt, a space of more than forty-five degrees, or 2700 geographical miles, by a breadth of twelve degrees, or 720 geographical miles. It is one prodigious expanse of red sand, and sandstone rock, of the granulations of which the red sand consists. It is, in truth, an empire of sand which seems to defy every exertion of human power or industry, although it is interspersed with various islands, and fertile and cultivated spots of different sizes, of which Fessan is the chief of those which have been hitherto explored.

Nearly in the centre of this sandy ocean, and nearly mid-way between the Mediterranean Sea and the coast of Guinea, rise the walls of Tombuctoo, the capital of the very interesting empire of Bembarra—a city which constitutes the great mart for the commerce of all the interior of Africa. To maintain this commerce is the laborious work of the *akkabaars*, or caravans, which cross this enormous desert from almost every part of the African coast. The mode in which it is traversed is highly curious.

The caravans consist of several hundred loaded camels, accompanied by the Arabs who let them out to the merchants for the transport of their goods. During their route, they are often exposed to the attacks of the roving Arabs of Sahara, who generally commit their depredations on the approach to the confines of the desert. In this tiresome journey, the caravans do not proceed to the place of their destination, in a direct line across the trackless desert, but turn occasionally eastward or westward, according to the situation of certain fertile, inhabited, and cultivated spots, called *oases*, interspersed in various parts

of the Sahara, like islands in the ocean. These serve as watering-places to the men, as well as to feed, refresh and replenish the hardy and patient camel. At each of these cultivated spots, the caravan sojourns about seven days, and then proceeds on its journey, until it reaches another spot of the same description. In the intermediate journies, the hot winds, denominated SHUME, or SIMOOM, are often so violent, as considerably, if not entirely, to exhale the water carried in skins by the camels for the use of the passengers and drivers. On these occasions it is affirmed by the Arabs, that five hundred dollars have been frequently given for a draught of water, and that ten or twenty dollars are commonly paid, when a partial exhalation has occurred. These scorching winds will be particularly described, in treating of atmospherical phenomena.

In 1805, a caravan proceeding from Tombuctoo to Tafilet, was disappointed in not finding water at one of the usual watering-places, when, horrible to relate, the whole of the persons belonging to it, two thousand in number, besides one thousand eight hundred camels, perished of thirst! Accidents of this nature, account for the vast quantities of human and other bones which are found heaped together in various parts of the desert.

The following is the general route of the caravans, in crossing the desert. Having left the city of Fez, the capital of Morocco, they proceed at the rate of three miles and a half an hour, and travel seven hours each day. In the space of eighteen days they reach Akka, where they remain a month, as this is the place of rendezvous at which they are formed into one grand accumulated caravan. In proceeding from Akka to Tagassa, sixteen days are employed; and here again, the caravan sojourns fifteen days to refresh the camels. It then directs its course to the *oasis* and well of Taudeny, which is reached in seven days; and, after another stay of fifteen days, proceed to Arawan, a watering-place, situated at a like distance. After having sojourned there fifteen days, it sets out, and reaches Tombuctoo on the sixth day, after having performed a journey of fifty-four days of actual travelling, and seventy-five of repose, making, altogether, from Fez to Tombuctoo, one hundred and twenty-nine days, or four lunar months and nine days.

Another caravan sets out from Wedinoon and Sok Assa, traversing the desert between the black mountains of Cape Bojador and Gualata: it touches at Tagassa and El Garbie, or West Tagassa, where having staid to collect salt, it proceeds to Tombuctoo. The time occupied by this caravan is five or six months, as it proceeds as far as Gibbelel-bied, or the white mountains, near Cape Blanco, through the deserts of Mograffira and Woled Abussebah, to a place named Agadeen, where it sojourns twenty days.

The caravans which cross the desert, may be compared to fleets of merchant vessels under convoy, the *stata*, or convoy of the desert consisting of a certain number of Arabs, belonging to the tribe through whose territory the caravan passes. Thus, in crossing the territory of Woled Abussebah, it is accompanied by Sebayhees, or people of that country, who, on reaching the confines of the territory of Woled Deleim, deliver their charge to the protection of the chiefs of that country. These, again, conduct it to the confines of the territory of the Mograffa Arabs, under whose care it at length reaches Tombuctoo. Any assault on the caravan during this journey, is considered as an insult to the whole tribe to which the convoy belongs; and for such an outrage they never fail to take ample revenge.

Besides these grand caravans, others cross the desert on an emergency, without a convoy, or guard. This is, however, a perilous expedition—as they are too often plundered near the northern confines of the desert, by two notorious tribes, named Dikna and Emjot. In the year 1798, a caravan consisting of two thousand camels, laden with the produce of the Souhann territory, together with seven hundred slaves, was plundered and dispersed, with great slaughter. These desperate attacks are conducted in the following manner. The tribe being assembled, the horses are picketed at the entrance of the tents, and scouts sent out, to give notice when a caravan is likely to pass.—These scouts being mounted on the heirie, or fleet horses of the desert, quickly communicate the intelligence, and the whole tribe mount their horses, taking with them a sufficient number of female camels, on whose milk they entirely subsist. Having placed themselves in ambush near an oasis, or watering-place, they issue thence on the

arrival of the caravan, which they plunder without mercy, leaving the unfortunate merchants entirely destitute.

The food, dress, and accommodations of the people who compose the caravans, are simple and natural. Being prohibited by their religion the use of wine and intoxicating liquors, and exhorted by its principles to temperance in all things, they are commonly satisfied with a few nourishing dates, and a draught of water, travelling for weeks successively without any other food. At other times, when they undertake a journey of a few weeks across the desert, a little barley meal, mixed with water, constitutes their only nourishment. In following up this abstemious mode of life, they never complain, but solace themselves with the hope of reaching their native country, singing occasionally during the journey, whenever they approach a habitation, or when the camels are fatigued. Their songs are usually sung *in trio;* and those of the camel-drivers who have musical voices, join in the chorus. These songs have a surprising effect in renovating the camels; while the symphony and time maintained by the singers, surpass what any one would conceive who has not heard them.—The day's journey is terminated early in the afternoon, when the tents are pitched, prayers said, and the supper prepared by sun-set. The guests now arrange themselves in a circle, and, the sober meal being terminated, converse till they are overcome by sleep. At day-break next morning, they again proceed on their journey.

PILGRIMAGE ACROSS THE DESERTS.

The following very lively description of a pilgrimage across the desert is given by Ali Bey, in his travels in Morocco, Tripoli, &c. It is an animated picture which pourtrays in the strongest colours the perils and sufferings encountered in these enterprises.

"We continued marching on in great haste, for fear of being overtaken by the four hundred Arabs whom we wished to avoid. For this reason we never kept the common road, but passed through the middle of the desert, marching through stony places, over easy hills. This country is entirely without water; not a tree is to be seen in it, not a rock which can afford a shelter or shade. A transparent atmosphere, an intense sun, darting its beams upon

our heads, a ground almost white, and commonly of a concave form, like a burning glass; slight breezes, scorching like a flame. Such is a faithful picture of this district, through which we were passing.

"Every man we meet in this desert is looked upon as an enemy. Having discovered about noon a man in arms, on horseback, who kept at a certain distance, my thirteen beduins united the moment they perceived him, darted like an arrow to overtake him, uttering loud cries, which they interrupted by expressions of contempt and derision; as, "*What are you seeking, my brother?*" "*Where are you going, my son?*" As they made these exclamations they kept playing with their guns over their heads. The discovered beduin profited of his advantage, and fled into the mountains, where it was impossible to follow him.—We met no one else.

"We had now neither eaten nor drank since the preceding day; our horses and other beasts were equally destitute; though ever since nine in the evening we had been travelling rapidly. Shortly after noon we had not a drop of water remaining, and the men, as well as the poor animals, were worn out with fatigue. The mules, stumbling every moment, required assistance to lift them up again, and to support their burden till they rose. This terrible exertion exhausted the little strength we had left.

"At two o'clock in the afternoon a man dropped down stiff, and as if dead, from great fatigue and thirst. I stopt with three or four of my people to assist him. The little wet which was left in one of the leathern budgets, was squeezed out of it, and some drops of water poured into the poor man's mouth, but without any effect. I now felt that my own strength was beginning to forsake me; and becoming very weak, I determined to mount on horseback, leaving the poor fellow behind. From this moment others of my caravan began to drop successively, and there was no possibility of giving them any assistance; they were abandoned to their unhappy destiny, as every one thought only of saving himself. Several mules with their burdens were left behind, and I found on my way two of my trunks on the ground, without knowing what was become of the mules which had been carrying them, the drivers

having forsaken them as well as the care of my effects and of my instruments.

I looked upon this loss with the greatest indifference, as if they had not belonged to me, and pushed on. But my horse began now to tremble under me, and yet he was the strongest of the whole caravan. We proceeded in silent despair. When I endeavoured to encourage any of the party to increase his pace, he answered me by looking steadily at me, and by putting his fore finger to his mouth to indicate the great thirst by which he was affected. As I was reproaching our conducting officers for their inattention, which had occasioned this want of water, they excused themselves by alledging the mutiny of the oudains; and besides, added they, "Do we not suffer like the rest?" Our fate was the more shocking, as every one of us was sensible of the impossibility of supporting the fatigue to the place where we were to meet with water again. At last, at about four in the evening, I had my turn and fell down with thirst and fatigue.

Extended without consciousness on the ground, in the middle of the desert, left only with four or five men, one of whom had dropped at the same moment with myself, and all without any means of assisting me, because they knew not where to find water, and, if they had known it, had not strength to fetch it, I should have perished with them on the spot, if Providence, by a kind of miracle, had not preserved us.

Half an hour had already elapsed since I had fallen senseless to the ground, (as I have since been told,) when, at some distance, a considerable caravan, of more than two thousand souls was seen advancing. It was under the direction of a marebout or saint called Sidi Alarbi, who was sent by the Sultan to Ttemsen or Tremecen. Seeing us in this distressed situation, he ordered some skins of water to be thrown over us. After I had received several of them over my face and hands, I recovered my senses, opened my eyes, and looked around me, without being able to discern any body. At last, however, I distinguished seven or eight sheriffs and fakeers, who gave me their assistance, and shewed me much kindness. I endeavoured to speak to them, but an invincible knot in my

throat seemed to hinder me; I could only make myself understood by signs, and by pointing to my mouth with my finger.

They continued pouring water over my face, arms, and hands, and at last I was able to swallow small mouth-fulls. This enabled me to ask, '*Who are you?*' When they heard me speak, they expressed their joy, and answered me, '*Fear nothing; far from being robbers, we are your friends;*' and every one mentioned his name. I began by degrees to recollect their faces, but was not able to remember their names. They poured again over me a still greater quantity of water, gave me some to drink, filled some of my leather bags, and left me in haste, as every minute spent in this place was precious to them, and could not be repaired.

This attack of thirst is perceived all of a sudden by an extreme aridity of the skin; the eyes appear to be bloody, the tongue and mouth both inside and outside are covered with a crust of the thickness of a crown piece; this crust is of a dark yellow colour, of an insipid taste, and of a consistence like the soft wax from a beehive. A faintness or languor takes away the power to move; a kind of knot in the throat and diaphragm, attended with great pain, interrupts respiration. Some wandering tears escape from the eyes, and at last the sufferer drops down to the earth, and in a few moments loses all consciousness. These are the symptoms which I remarked in my unfortunate fellow travellers, and which I experienced myself.

I got with difficulty on my horse again, and we proceeded on our journey. My Beduins and my faithful Salem were gone on different directions to find out some water, and two hours afterwards they returned one after another, carrying along with them some good or bad water, as they had been able to find it; every one presented to me part of what he had brought; I was obliged to taste it, and I drank twenty times, but as soon as I swallowed it my mouth became as dry as before; at last I was not able either to spit or to speak.

The greatest part of the soil of the desert consists of pure clay, except some small traces of a calcareous nature. The whole surface is covered with a bed of chalky calcareous stone of a whitish colour, smooth, round, and loose,

and of the size of the fist; they are almost all of the same dimension, and their surface is carious like pieces of old mortar; I look upon this to be a true volcanic production. This bed is extended with such perfect regularity, that the whole desert is covered with it; a circumstance which makes pacing over it very fatiguing to the traveller.

Not any animal is to be seen in this desert, neither quadrupeds, birds, reptiles, nor insects, nor any plant whatever; and the traveller who is obliged to pass through it, is surrounded by the silence of death. It was not till four in the evening that we began to distinguish some small plants burnt with the sun, and a tree of a thorny nature, without blossom or fruit."

SANDS OF THE DESERT.

Now o'er their head the whizzing whirlwinds breathe,
And the live desert pants, and heaves beneath;
Tinged by the crimson sun, vast columns rise
Of eddying sands, and war amid the skies,
In red arcades the billowy plain surround,
And stalking turrets dance upon the ground.

DARWIN.

In the pathless desert, high mounds of sand, shifting with every change of wind, surround the travellers on every side, and conceal from his view all other objects. There the wind is of a surprising rapidity, and the sand so extremely fine, that it forms on the ground waves which resemble those of the sea. These waves rise up so fast, that in a very few hours a hill of from twenty to thirty feet high is transported from one place to another. The shifting of these hills, however, does not take place on a sudden, as is generally believed, and is not by any means capable of surprising and burying a caravan while on the march. The mode in which the transposition of the hills takes place is not difficult of explanation. The wind sweeping the sand from the surface continually, and that with an astonishing rapidity, the ground lowers every moment: but the quantity of sand in the air increasing as quickly by successive waves, cannot support itself there, but falls in heaps, and forms a new hill, leaving the place it before occupied level, and with the appearance of having been swept.

It is necessary to guard the eyes and mouth against the quantity of sand which is always flying about in the air; and the traveller has to seek the right direction, to avoid being lost in the windings made in the middle of the hills of sand which bound the sight, and which shift from one spot to another so often, as not to leave any thing to be seen besides the sky and sand, without any mark by which the position can be known. Even the deepest footstep in the sand of either man or horse disappears the moment the foot is raised.

The immensity, the swiftness, and the everlasting motion of these waves disturb the sight both of men and beasts, so that they are almost continually marching as if in the dark. The camel gives here a proof of his great superiority; his long neck, perpendicularly erected, removes his head from the ground, and from the thick part of the waves; his eyes are well defended by thick eye-lids, largely provided with hair, and which he keeps half shut; the construction of his feet, broad and cushion-like, prevents his treading deep into the sand; his long legs enable him to pass the same space with only half the number of steps of any other animal, and therefore with less fatigue. These advantages give him a solid and easy gait, on a ground where all other animals walk with slow, short, and uncertain steps, and in a tottering manner. Hence the camel, intended by nature for these journeys, affords a new motive of praise to the Creator, who in his wisdom has given the camel to the African as he has bestowed the rein-deer on the Laplander.

Lieutenant Pottinger, in his travels in Beloochistan, a province of India, gives the following interesting account of those curious phenomena. He had to pass over a desert of red sand, the particles of which were so light, that when taken in the hand they were scarcely more than palpable, the whole being thrown by the winds into an irregular mass of waves, principally running east and west, and varying in height from ten to twenty feet. The greater part of them rose perpendicularly on the opposite side to that from which the prevailing north-west wind blew, and might readily have been fancied, at a distance, to resemble a new brick wall. The side facing the wind sloped off with a gradual declivity towards the base of the next windward

wave, again ascending in a strait line, in the same extraordinary manner as above described, so as to form a hollow or path between them. Our traveller kept as much in these paths as the direction he had to take would allow; but it was not without great difficulty and fatigue that the camels were urged over the waves, when it was requisite to do so, and more particularly when they had to clamber up the lee-ward or perpendicular face of them, in attempting which they were often defeated. On the oblique, or shelving side they ascended pretty well, their broad feet saving them from sinking deeper than did the travellers themselves; and the instant they found the top of the wave giving way from their weight, they most expertly dropped on their knees, and in that posture gently slid down with the sand, which was luckily so unconnected, that the leading camel usually caused a sufficient breach for the others to follow on foot. The night was spent under shelter of one of these sand waves, the surrounding atmosphere being uncommonly hot and close.

On the following day, in crossing a desert of the same description, the like impediments occurred; but these were trifling compared with the distress suffered, not only by our traveller and his people, but also by the camels, from the floating particles of sand—a phenomenon for which he confesses himself at a loss to account. When he first observed it, in the morning, the desert appeared to have, at the distance of half a mile or less, an elevated and flat surface from six to twelve inches higher than the summits of the sand waves. This vapour appeared to recede as he advanced, and once or twice completely encircled his party, limiting the horizon to a very confined space, and conveying a most gloomy and unnatural sensation to the mind of the beholders, who were at the same moment imperceptibly covered with innumerable atoms of small sand, which getting into the eyes, mouth and nostrils, caused excessive irritation, attended by an extreme thirst, which was increased in no small degree by the intense heat of the sun. This annoyance is supposed by the natives to originate in the solar beams causing the dust of the desert, as they emphatically call it, to rise and float through the air—a notion which appears to be in a great measure correct, this sandy ocean being only visible during the hottest part of the day.

The following simple theory of these moving sands is submitted by the author. When the violent whirlwinds which prevail in the desert, terminate in gusts of wind, they usually expand over several square miles of surface, raging with irresistable force, and bearing upwards an immense body of sand, which descends as the current of air that gave it action dies away, thus creating the extraordinary appearance in question. If it should be asked what prevents the sand from subsiding altogether, when it has so far accomplished this as to rest apparently on the waves, the answer is, that all the grosser particles do settle, but that the more minute ones become rarified to such a degree by the heat produced by the burning sand on the red soil, that they remain as it were in an undecided and undulating state, until the returning temperature restores their specific gravity, when by an undeviating law of nature, they sink to the earth. This in some measure coincides with the opinion of the native Brahoes; but, conformably to their notion, it is evident that the floating sands would be apparent at all periods of excessive solar influence, which not being the case, it becomes necessary to find a primary cause for the phenomenon. To remove any suspicion of his having been deceived in the reality of this floating vapour of sand, he adds that he has seen this phenomenon, and the Shurab, or watery illusion so frequent in deserts, called by the French *mirage*, in opposite quarters at the same moment, each of them being to his sight perfectly distinct. While the former had a cloudy and dim aspect, the latter was luminous, and could not be mistaken for water. To corroborate what he has here advanced, he states that he was afterwards joined by a fakeer from Kaboul, who informed him that he had witnessed the moving sands, in passing through the desert from Seistan, to a much greater degree than has been described; and, what is scarcely credible, he spoke of having been forced to sit down, in consequence of the density of the cloud in which he was enveloped.

Our traveller next proceeds to a curious description of the pillars or columns of sand formed in the deserts. He experienced a violent tornado, or gust of wind, which came on so suddenly, that, if he had not been apprized of its strength by the guide, it might have been disastrous to his party, in whom it would have been an act of teme-

rity to have endeavoured to sit on the camels during its impetuous fury. Before it began, the sky was clear, save a few small clouds in the north-west quarter; and the only warnings it afforded, were the oppressive sultriness of the air, and a vast number of whirlwinds springing up on all sides. These whirlwinds, he observes, might perhaps be more correctly expressed by some other name; but as the wind issued from them he adopts the term. They are vast columns of sand, which begin by a trifling agitation, with a revolving motion on the surface of the desert, and gradually ascend and expand, until their tops are lost to the view. In this manner they move about with every breath of wind, and are observed, thirty or forty of them at the same time, of different dimensions, apparently from one to twenty yards in diameter. Those who have seen a water-spout at sea, may exactly conceive the same formed of sand on shore. The moment the guide saw the whirlwinds disperse, which they did as if by magic, and a cloud of dust approaching, he advised the party to dismount, which they had hardly time to do, and lodge themselves snugly behind the camels, when a storm burst upon them with a furious blast of wind, the rain falling in huge drops, and the air being so completely darkened, that they were unable to discern any object at the distance of even five yards.

The following is Bruce's account of this singular phenomenon, which he represents as one of the most magnificent spectacles imaginable, and by which himself and his companions were at once surprised and terrified. Having reached the vast expanse of desert which lies to the west and north-west of Chendi, they saw a number of prodigious pillars of sand at different distances, at times moving with great celerity, and at others stalking on with a majestic slowness. At intervals the party thought they should be overwhelmed by these sand pillars; and small quantities of sand did actually more than once reach them. Again, they would retreat so as to be almost out of sight, their summits reaching to the very clouds. There the tops often separated from the bodies; and these once disjointed, dispersed in the air, and did not appear more. They were sometimes broken near the middle, as if struck by a large cannon-shot. About noon they began to advance with consi-

derable swiftness upon the party, the wind being very strong at north. Eleven of them ranged alongside, at about the distance of three miles from them; and at this interval the greatest diameter of the largest of them appeared to Mr. Bruce to be about ten feet. They retired with a wind at south-east, leaving an impression on our traveller's mind, to which he could give no name, though assuredly one of its ingredients was fear, blended with a considerable portion of wonder and surprise. It was in vain to think of fleeing: the swiftest horse, or fastest-sailing ship, would not have been of any use in rescuing him from his danger. The full persuasion of this riveted him as it were to the spot where he stood, and he allowed the camels to gain on him so much, that it was with difficulty he could overtake them.

On a subsequent occasion, an assemblage of these moving pillars of sand, more numerous, but less in size than the former, approached Mr. Bruce's party soon after sunrise, and appeared like a thick wood. They almost darkened the sun, the rays of which, shining through them for nearly an hour, gave them an appearance of pillars of fire. His people became desperate, some saying it was the day of judgment—and others, that the world was on fire.

Dr. Clarke, in his more recent travels in Egypt, thus describes this phenomenon.

One of those immense columns of sand, mentioned by Bruce, came rapidly towards us, turning upon its base as upon a pivot: it crossed the Nile so near us, that the whirlwind by which it was carried, placed our vessel upon its beam-ends, bearing its large sail quite into the water, and nearly upsetting the boat. As we were engaged in righting the vessel, the column disappeared. It is probable that those columns do not fall suddenly upon any particular spot, so as to be capable of overwhelming an army or a caravan; but that, as the sand, thus driven, is gradually accumulated, it becomes gradually dispersed, and the column, diminishing in its progress, at length disappears. A great quantity of sand is no doubt precipitated as the effect which gathers it becomes weaker; but, from witnessing such phenomena upon a smaller scale, it does not seem likely that the whole body of the sand is at once abandoned.

MINES, METALS, AND GEMS.

[*See Plates, No.* 38, 39, 40, 41.]

Through dark retreats pursue the winding ore,
Search nature's depths, and view her boundless store;
The secret cause in tuneful numbers sing,
How metals first were framed, and whence they spring:
Whether the active sun, with chymic flames,
Through porous earth transmits his genial beams;
With heat impregnating the womb of night,
The offspring shines with his paternal light:
Or whether, urged by subterraneous flames,
The earth ferments, and flows in liquid streams;
Purged from their dross, the nobler parts refine,
Receive new forms, and with fresh beauty shine:—
Or whether by creation first they sprung,
When yet unpoised the world's great fabric hung:
Metals the basis of the earth were made,
The bars on which its fixed foundation's laid—
All second causes they disdain to own,
And from the Almighty's fiat sprung alone.

YALDEN.

THOSE excavations in which metals, minerals, and precious stones are dug, are called MINES, and receive, from the substances they yield, various denominations. The richest and most celebrated gold and silver mines are those of Mexico and Peru, in South America. Iron mines are more abundant in Europe than elsewhere. Copper mines are chiefly found in England, Sweden, and Denmark; and lead and tin mines in England: the latter, more particularly in the county of Cornwall. Quicksilver mines abound principally in Hungary, Spain, Friuli, in the Venitian territory, and Peru; diamond mines, in the East Indies, and in the Brazils; and salt mines in Poland.

To explain the structure of mines, it should be observed that the internal parts of the earth, as far as they have yet been investigated, do not consist of one uniform substance, but of various strata, or beds, of substances, extremely different in their appearances, specific gravities, and chemical qualities, from one another. Neither are these strata similar to each other, either in their nature or appearance, in different countries; insomuch that, even in the short extent of half a mile, the strata will be found quite different from what they are in another place. As little are

they the same either in depth or solidity. Innumerable cracks and fissures are found in all of them; but these are so entirely different in size and shape, that it is impossible to form any inference from what may have been met with, relative to that which remains to be explored. In these fissures the metallic ore is contained.

In Cornwall, the most common opinion entertained by the miners is, that crude immature minerals nourish and feed the ores with which they are intermixed in the mines; and that the minerals themselves will, in process of time, be converted into ores productive of those metals to which they have the nearest affinity, and with which they have the greatest intercourse. In his mineralogy of Cornwall, Mr. Price thinks it most reasonable to conclude, that metals were made and planted in veins, at, or very soon after, the creation of the world: but that, in common with all other matter, they are subject to a degree of fluctuation, approaching to, or receding from, their ultimate degree of perfection, either quicker or slower, as they are of greater or less solid and durable frame and constitution. He supposes in every metal a peculiar magnetism, and an approximation of particles of the same specific nature, by which its component principles are drawn and united together; more particularly the matters left by the decomposition of the waters passing through the contiguous earths or strata, and deposited in their proper *nidus* or receptacle, until, by the accretion of more or less of its homogeneous particles, the metallic vein may be denominated either rich or barren.

DIAMOND MINES.

The high value attached to diamonds does not depend so much on their beauty and hardness, as on their great scarcity, and the labour and expense necessary in procuring them. Hitherto they have been observed in the torrid zone alone; and Brazil is the only part of the Americas in which they have been found. The historical account of their discovery in that country is as follows. Near the capital of the territory of Serro do Frio flows the river Milho Verde, where it was the custom to dig for gold, or rather to extract it from the alluvial soil. The miners, during their search for gold, found several diamonds, which

they were induced to lay aside in consequence of their particular shape and great beauty, although they were ignorant of their intrinsic value.

The diamond works on the river Jigitonhonha are described by Mr. Mawe as the most important in the Brazilian territory. The river, in depth from three to nine feet, is intersected by a canal, beneath the head of which it is stopped by an embankment of several thousand bags of sand, its deeper parts being laid dry by chain-pumps. The mud is now washed away, and the *cascalhao*, or earth which contains the diamonds, dug up, and removed to a convenient place for washing. The process is as follows. A shed, consisting of upright posts, which support a thatched roof, is erected in the form of a parallelogram, in length about ninety feet, and in width forty-five. Down the middle of its area a current of water is conveyed through a canal covered with strong planks, on which the earth is laid to the thickness of two or three feet. On the other side of the area is a flooring of planks, from twelve to fifteen feet in length, imbedded in clay, extending the whole length of the shed, and having a gentle slope from the canal. This flooring is divided into about twenty compartments, or troughs, each about three feet wide, by means of planks placed on their edges; and the upper end of these troughs communicate with the canal, being so formed that water is admitted into them between two planks about an inch separate from each other. Through this opening the current falls about six inches into the trough, and may be directed to any part of it, or stopped at pleasure, by means of a small quantity of clay. Along the lower ends of the troughs a small channel is dug, to carry off the water.

On the heap of earth, at equal distances, three high chairs are placed for the overseers, who are no sooner seated than the negroes enter the troughs, each provided with a rake of a peculiar form, and having a short handle, with which he rakes into the trough from fifty to eighty pounds weight of the earth. The water being then allowed to pass in by degrees, the earth is spread abroad, and continually raked up to the head of the trough, so as to be kept in constant motion. This operation is continued for a quarter of an hour, when the water begins to run clearer;

and, the earthy particles having been washed away, the gravel-like matter is raked up to the end of the trough. At length the current flowing quite clear, the largest stones are thrown out, and afterwards those of an inferior size: the whole is then examined with great care for diamonds. When a negro finds one, he immediately stands upright, and claps his hands: he then extends them, holding the gem between the fore finger and the thumb. An overseer receives it from him, and deposits it in a bowl, suspended from the centre of the structure, and half-filled with water. In this vessel all the diamonds found in the course of the day are deposited, and at the close of the work are taken out and delivered to the principal overseer, who, after they have been weighed, registers the particulars in a book kept for that purpose.

When a negro is so fortunate as to find a diamond of the weight of seventeen carats and a half, the following ceremony takes place: he is crowned with a wreath of flowers, and carried in procession to the administrator, who gives him his freedom by paying his owner for it. He also receives a present of new clothes, and is permitted to work on his own account. For small stones proportionate premiums are given; while many precautions are taken to prevent the negroes from stealing the diamonds, with which view they are frequently changed by the overseers, lest these precious gems should be concealed in the corners of the troughs. When a negro is suspected of swallowing a diamond, he is confined in a solitary apartment, and means taken to bring the gem to light.

In the EAST INDIES, THE KINGDOM OF GOLCONDA, extending two hundred and sixty miles along the bay of Bengal, and having a breadth of two hundred miles from east to west, abounds in DIAMOND MINES. They are chiefly in the vicinity of the rocky hills and mountains which intersect the country, and in the whole of which diamonds are supposed to be contained. In several of the mines they are found scattered in the earth, within two or three fathoms of the surface, and in others are met with in a mineral substance in the body of the rocks, forty or fifty fathoms deep. The labourers having dug five or six feet into the rock, soften the stone by fire, and proceed till they find the vein, which often runs two or three furlongs under

the rock. The earth being brought out, and carefully searched, affords stones of various shapes, and of a good water. This earth is of a yellowish, and sometimes of a reddish colour, frequently adhering to the diamond with so strong a crust that the separation becomes difficult.

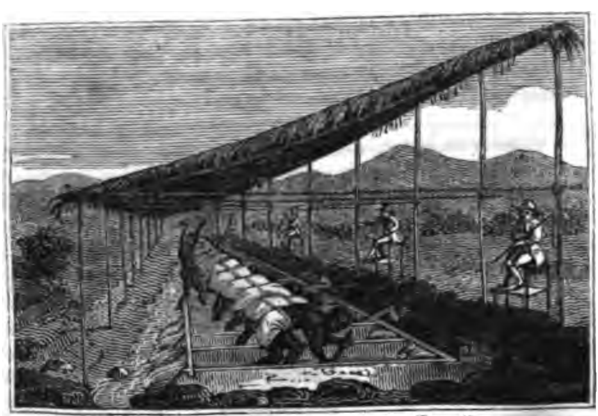
To find the diamonds, the workmen form a cistern of a kind of clay, with a small vent on one side, a little above the bottom; in this vent they place a plug, and throwing into the cistern the earth they have dug, pour in water to dissolve it. They then break the clods, and stir the wet earth in the cistern, allowing the lighter part to be carried off in the form of mud, when the vent hole is opened to let out the water. They thus continue washing until what remains in the cistern is pretty clean; and then, in the middle of the day, when the sun shines bright, carefully look over all the sand, at which practice they are so expert, that the smallest stone cannot escape them. The brightness of the sun being reflected by the diamonds, aids them in their research, which would be foiled if a cloud were to intervene.

The specific gravity of the diamond is to that of water in the proportion of somewhat more than three and a half to one. It is the hardest of all precious stones, and can only be cut and ground *by itself and its own substance*. To bring it to the perfection by which its price is so greatly augmented, the lapidary begins by rubbing several of these stones against each other, while rough, having first glued them to the ends of two wooden blocks, thick enough to be held in the hand. The powder thus rubbed off the stones and received in a small box for the purpose, serves to grind and polish them.

The greatest known diamond was found in Brasil, and belongs to the King of Portugal. It weighs 1680 carats; and, although uncut, is estimated by Rome de l'Isle at the enormous sum of two hundred and twenty-four millions sterling, which gives an estimate of nearly eighty pounds sterling for each carat, the multiplicand of the square of its whole weight being taken. The one next in magnitude and value is that purchased in 1772 by the late Empress of Russia: it weighs seven hundred and seventy-nine carats, and has been estimated at nearly five millions sterling. It ought, however, to be observed, that these estimates, founded on the magnitude and brilliancy of the gems, are



No. 38.—Gold Washing in Brazil.



No. 39.—Diamond Washing in Brazil.

very different from the prices which the most princely fortunes can afford to pay for them. The diamond in question cost about one hundred and thirty-five thousand pounds sterling; and the one called the PITT or REGENT, although it weighed one hundred and thirty-six carats only, was, on account of its greater brilliancy, purchased of a Greek merchant for one hundred thousand pounds sterling. Several other large diamonds are preserved in the cabinets of the Sovereigns and Princes of Europe.

GOLD AND SILVER MINES.

The mines of LA PLATA, so denominated on account of the abundance of silver they contain, are chiefly situated in the provinces which were strictly considered as Peruvian, before the new partition of territory in 1778; Charcas, Tucuman, and even Buenos Ayres, being then considered as dependencies of Peru. With the exception of New Spain, the upper part of the Viceroyalty of La Plata is the richest country in silver which has yet been discovered, and contains innumerable mines both of that metal and of gold. All its northern provinces teem with mineral opulence; and those of Laricaja and Carabaya are distinguished by the production of the latter, and still nobler metal, in its virgin state.

The mountain of Potosi alone produces weekly about five thousand marks of silver, that is, from thirty to forty thousand dollars—a surprising produce, when it is considered that it has been wrought since 1545, at which time it was accidentally discovered by an Indian. At the commencement it was still more abundant, and the metal was dug up in a purer state; but it is still considered as the most sure and permanent mine. The silver is often found in shoots imbedded in the earth. Six thousand Indians are sent every eighteen months, from the provinces of the Viceroyalty, to work this mine. The expedition is called *mita;* and these Indians, having been enrolled and formed into parties, are distributed by the governor of Potosi, and receive a small daily stipend, (equal to about eighteen pence English) until the period of their labour is completed. They are thus condemned to a forced service, which is nothing less than slavery, so long as it lasts, and which the

Spaniards endeavour to justify by the plea that labourers could not otherwise be procured. The mita having thus, according to them, been rendered indispensable, they observe that it is conducted with all possible humanity; which those may believe who have never heard of the cruelties they have exercised, it may be said habitually, on the wretched Indians, since the conquest.

Lumps of pure gold and silver, called *papas*, from their resemblance to the potatoe, are often found in the sands. The poor likewise occupy themselves in *lavederos*, or in washing the sands of the rivers and rivulets, in order to find particles of the precious metals.

To compensate for the mines which are rendered useless by the irruption of water, or other accidents, rich and new ones are daily discovered. They are all found in the chains of mountains, commonly in dry and barren spots, and sometimes in the sides of the *quebredas*, or astonishing precipitous breaks in the ridges. However certain this rule may be in the Viceroyalty of Buenos Ayres, it is contradicted in that of Lima, where, at three leagues distance from the Pacific Ocean, not far from Tagna, in the province of Africa, there was discovered not many years ago the famous mine of Huantajaya, in a sandy plain at a distance from the mountains, of such exuberant wealth that the pure metal was cut out with a chisel. From this mine a large specimen of virgin silver is preserved in the royal cabinet of natural history at Madrid. It attracted a considerable population, although neither water nor the common conveniences for labour could be found on the spot, nor was there any pasturage for the cattle.

In the mint of Potosi about six millions of dollars are annually coined; and the mines of the viceroyalty of La Plata, taken collectively, are reckoned to yield about sixteen millions. The new viceroyalty of Buenos Ayres contains thirty gold mines, twenty-seven silver mines, and sixteen of other metals.

The mines of MEXICO, or NEW SPAIN, have been more celebrated for their riches than those of La Plata, notwithstanding which they are remarkable for the poverty of the mineral they contain. A quintal, or one thousand six hundred ounces of silver ore, affords, at a medium, not more than three or four ounces of pure silver, about one third of

what is yielded by the same quantity of mineral in Saxony. It is not, therefore, owing to the richness of the ore, but to its abundance, and the facility of working it, that the mines of New Spain are so much superior to those of Europe.

The fact of the small number of persons employed in working them, is not less contrary to the commonly received opinion on this subject. The mines of Guanaxato, infinitely richer than those of Potosi ever were, afforded from 1796 to 1803, nearly forty millions of dollars in gold and silver, or very nearly five millions of dollars annually, being somewhat less than one fourth of the whole quantity of gold and silver from New Spain; notwithstanding which, these mines, productive as they were, did not employ more than five thousand workmen of every description. In Mexico, the labour of the mines is perfectly free, and better paid than any other kind of industry, a miner earning from five to five dollars and a half weekly, while the wages of the common labourer do not exceed a dollar and a half. The *tenateros*, or persons who carry the ore on their backs, from the spot where it is dug out of the mine, to that where it is collected in heaps, receive a sum equal to five English shillings for a day's work of six hours. Neither slaves, criminals, nor forced labourers, are employed in the Mexican Mines.

In consequence of the clumsy, imperfect, and expensive mode of clearing them from water, several of the richest of these mines have been overflowed and abandoned; while the want of method in the arrangement of the galleries, and the absence of lateral communications, add to the uncertainty, and greatly increase the expense of working them. Labour is not, as in the working of the European mines, abridged, nor the transport of materials facilitated. When new works are undertaken, a due consideration is not bestowed on the preliminary arrangements; and they are always conducted on too large and expensive a scale.

More than three-fourths of the silver obtained from America is extricated from the ore by the means of quicksilver, the loss of which, in the process of amalgamation, is immense. The quantity consumed annually in New Spain alone is about sixteen thousand quintals; and, in the whole of America, about twenty-five thousand quintals are an-

nually expended, the cost of which, in the colonies, has been estimated at one-fourth of a million sterling. The greater part of this quicksilver has been lately furnished by the mine of Almaden in Spain, and that of Istria in Carniola, the celebrated quick-silver mine of Huancavelica in Peru having greatly fallen off in its produce, since the sixteenth century, when it was highly flourishing. The prosperity of the silver mines, both in Mexico and Peru, therefore greatly depends on the supplies of quicksilver from Spain, Germany, and Italy; for such is the abundance of the ore in those kingdoms, that the only limit to the quantity of silver obtained there, is the want of mercury for amalgamation.

In taking a general view of the riches of the other provinces of America, Mr. Humboldt, who has supplied these details, remarks that, in Peru, silver ore exists in as great abundance as in Mexico, the mines of Lauricocha being capable of yielding as great a produce as those of Guanaxuato; but that the art of mining, and the methods of separating the silver from its ore, are still more defective than in New Spain. Notwithstanding this imperfect system, the total amount of the precious metals annually furnished by America, is estimated at upwards of nine millions and a half sterling—the gold being in proportion to the silver as one to forty-six. From 1492 to 1803, the quantity of gold and silver extracted from the American mines has been equal in value to 5,706,700,000 dollars; of which immense sum, the portion brought into Europe, including the booty made by the conquerors of America, is estimated at 5,445,000,000, giving an average of seventeen million and a half of dollars yearly. The annual importation being divided into six periods, appears to have been constantly augmenting, and in the following progressive ratio. From 1492 to 1500, it did not exceed 250,000 dollars. From 1500 to 1545, it amounted to three millions of dollars. From 1545 to 1600, to eleven millions. From 1600 to 1700 to sixteen millions. From 1700 to 1750, to twenty-two millions and a half. And, lastly, from 1750 to 1803, to the prodigious sum of thirty-five millions three hundred thousand dollars, nearly equal to eight millions sterling.

The first period was that of exchange with the natives, or of mere rapine. The second was distinguished by the

conquest and plunder of Mexico, Peru, and New Granada, and by the opening of the first mines. The third began with the discovery of the rich mines of Potosi; and in the course of it the conquest of Chili was completed, and various mines opened in New Spain. At the commencement of the fourth period, the mines of Potosi began to be exhausted; but those of Lauricocha were discovered, and the produce of New Spain rose from two millions to five millions of dollars annually. The fifth period began with the discovery of gold in Brazil; and the sixth is distinguished by the prodigious increase of the mines of New Spain, while those of every other part of America, with the exception of the Brazils, have been constantly improving.

The GOLD MINES of BRAZIL are very productive. Those called GENERAL are distant about seventy-five leagues from Rio Janeiro, which is the staple and principal outlet of the riches of the Brazilian territory. They yield to the king, annually, for his right of fifths, at least one hundred and twelve arobas [weighing twenty-five pounds each] of gold. Their yearly produce may, therefore, be estimated at upwards of eight hundred thousand pounds sterling; and that of the more distant mines at about one third the sum.

The gold drawn from them cannot be carried to Rio Janeiro, without being first brought to the smelting houses established in each district, where the right of the crown is received. What belongs to private persons is remitted in bars, with their weight, number, and an impression of the royal arms. The gold is then assayed, and its standard imprinted on each bar. When these bars are carried to the mint, their value is paid to the possessor in coin, commonly in half-doubloons, each worth eight Spanish dollars. Upon each of these half-doubloons the king gains a dollar. by the alloy and right of coinage. The mint of Rio Janeiro is one of the most beautiful in existence, and is furnished with every convenience for working with the greatest celerity. As the gold arrives from the mines at the same time that the fleets arrive from Portugal, it is necessary to accelerate the operations of the mint, and the coinage proceeds with surprising quickness.

In AFRICA, the kingdom of MOZAMBIC abounds in gold,

which is washed down by the rivers, and forms a chief part of the commerce of the country. The kingdoms of MONOMOTAPA and SOFALA likewise furnish considerable quantities of gold; and the Portuguese who reside in the latter territory, report that it yields annually two millions of *metigals*, equal to somewhat more than a million sterling. The merchants export from Mecca, and other parts, about the same quantity of gold. The soldiers are paid in gold dust, in the state in which it is collected; and this is so pure, and of so fine a yellow, as not to be exceeded, when wrought, by any other gold beside that of Japan. Gold is likewise found on the island of Madagascar. The gold coast is so denominated from the abundance of gold found among the sands: it is not, however, so productive as has been generally supposed, owing to the intense heats, which, in a great measure, prevent the natives from prosecuting their researches.

In ASIA, the ISLAND OF JAPAN is most productive of gold, which is found in several of its provinces, and is, in by far the greater proportion, melted from its ore. It is likewise procured by washing the sands, and a small quantity is likewise found in the ore of copper. The emperor claims a supreme jurisdiction, not only over the gold mines, but over all the mines of the empire, which are not allowed to be worked without a licence from him. Two thirds of their produce belong to him, and the other third is left to the governor of the province in which the mines are situated. But the richest gold ore, and that which yields the finest gold, is dug in one of the northern provinces of the island of Niphon, a dependency of Japan, where the gold mines have been highly productive until latterly, though they have much fallen off. In the Japanese province of Tsckungo, a rich gold mine, having been filled with water, was no longer worked: as it was however, so situated, that, by cutting the rock, and making an opening beneath the mine, the water could be easily drawn off, this was attempted. At the moment of commencing the operation, so violent a storm of thunder and lightning arose, that the workmen were obliged to seek shelter elsewhere; and these superstitious people imagining that the tutelar god and protector of the spot, unwilling to have the bowels of the earth thus rifled, had raised the

storm to make them sensible of his great displeasure at such an undertaking, desisted from all further attempts, through the fear of incurring his displeasure.

Thibet, a mountainous country of India, contains a great abundance of gold, which is traced in the rivers flowing from that territory into the Ganges. In Hindostan there are not any mines of gold; but in the Irnada district gold is collected in the river which passes Nelambur in the Mangery Talui, a Nair having the exclusive privilege of this collection, for which he pays a small annual tribute. Silver is in general rare throughout the oriental regions, and there is not any indication of this metal in India; but in Japan there are several silver mines, more particularly in the northern provinces, and the metal extracted from them is very pure and fine.

Turning to Europe, Dalmatia is said in ancient times to have produced an abundance of gold. Pliny reports that in the reign of the emperor Nero, fifty pounds of this precious metal were daily taken from the mines of that province; and that it was found on the surface of the ground. It is added that Vibius, who was sent by Augustus to subdue the Dalmatians, obliged that hardy and warlike people to work in the mines, and to separate the gold from the ore.

Bossina, in Sclavonia, contains many mineral mountains, and has rich mines of gold and silver. The district in which the latter are found is named the *Srebrarniza*, being derived from the word *srebr*, which signifies silver in all the Sclavonian dialects. Their produce resembles the native silver of Potosi, and is found, combined with pure quartz, in small, thin leaves, resembling moss.

The kingdom of Norway formerly produced gold; but the expense of working the mines, and procuring the pure ore, being greater than the profit, these have been neglected. There are, however, silver mines, which are extremely valuable, and give employment to several thousands of persons. The principal of these is at Konigsberg, and was discovered in 1623, when the town was immediately built, and peopled with German miners. In 1751, forty-one shafts, and twelve veins, were wrought in this mine, and gave employment to three thousand five hundred officers, artificers, and labourers.

The silver ore is not, as was at first imagined, confined to the mountain between Konigsberg and the river Jordal, but extends its veins for several miles throughout the adjacent districts, in consequence of which new mines have been undertaken in several places, and prosperously carried on. One of the richest and most ancient of the mines, named "Old God's blessing," has sometimes, in the space of a week, yielded several hundred pounds weight of rich ore. The astonishing depth of this mine, which is not less than a hundred and eighty fathoms perpendicular, fills the mind of the beholder with amazement; and the circumference at the bottom forms a clear space of several hundreds of fathoms. Here the sight of thirty or forty piles, burning on all sides in this gloomy cavern, and continually fed to soften the stone in the prosecution of the labours, seems, according to the notions commonly entertained, an apt image of hell; and the swarms of miners, covered with soot, and bustling about in habits according to their several employments, may well pass for so many infernal spirits; more especially when, at a given signal when the mine is to be sprung in this or that direction, they exclaim aloud: "Berg-livet, berg-livet!" Take care of your lives.

The gold mines of Cremnitz lie forty miles south of the Carpathian hills; and twenty miles farther to the south, are the silver mines of Shemnitz. These are called mining towns; and the former is the principal, its rich ores being found in what is styled metallic rock. Its mines also produce a certain proportion of silver. Hungary is beside enriched by a mineral peculiar to itself, or one, at least, which has not hitherto been discovered elsewhere, namely, the opal—a gem preferred to all others by the oriental nations. The opal mines are situated at Ozerwiniza, where they are found in a hill consisting of decomposed porphyry, a few fathoms beneath the surface. Their produce is of various qualities, from the opake-white, or semi-opal, to the utmost refulgence of the lively colours by which this noble gem is distinguished.

Transylvania and the Bannet contain numerous and valuable mines, consisting chiefly of grey gold ore, and white gold ore. The finest gold is found at Olapian, not far from Zalathna, intermixed with gravel and sand. The

sands of the Rhine, on the shores near Germerscheim and Sels, also contain gold.

The mountains of SPAIN were, according to ancient writers, very rich in gold and silver; and accordingly Gibbon calls that kingdom "the Perú and Mexico of the old world." He adds that, "the discovery of the rich western continent by the Phenicians, and the oppression of the simple natives, who were compelled to labour in their own mines for the benefit of strangers, form an exact type of the more recent history of Spanish America." The Phenicians were simply acquainted with the sea-coasts of Spain; but avarice as well as ambition carried the arms of Rome and Carthage into the heart of the country, and almost every part of the soil was found pregnant with gold, silver and copper. A mine near Carthagena is said to have yielded daily twenty-five thousand drachms of silver, or three hundred thousand pounds sterling a year. The provinces of Asturia, Gallicia, and Lusitania, yielded twenty thousand pounds weight of gold annually: the modern Spaniards have, however, chosen rather to import the precious metals from America, than to seek them at home.

PORTUGAL is in many parts mountainous, and these mountains contain, beside others, rich ores of silver; but the Portuguese, like the Spaniards, being supplied with metals from their transatlantic possessions, and particularly with an abundance of gold and silver from Brazil, do not work the mines in their own country. Gems of all kinds, as turquoises and hyacinths, are also found in the above mountains, together with a beautifully variegated marble, and many curious fossils.

QUICKSILVER MINES.

THE quicksilver mines of IDRIA are the most interesting of these, and demand a particular description, as they have been celebrated in natural history, poetry, and romance. The ban of Idria is a district immediately subject to the Chamber of Inner Austria, and lies westward of Carniola. The town, which is small, is seated in a deep valley, amid high mountains, on the river of the same name, and at the bottom of so steep a descent, that its approach is a task of great difficulty, and sometimes of danger.

The mines were discovered in 1497, before which time

that part of the country was inhabited by a few coopers only, and other artificers in wood, with which the territory abounds. One evening, a cooper having placed a new tub under a dropping spring, to try if it would hold water, on returning next morning, found it so heavy that he could scarcely move it. He at first was led by his superstition to suspect that the tub was bewitched; but perceiving at length a shining fluid at the bottom, with the nature of which he was unacquainted, he collected it, and proceeded to an apothecary at Laubach, who, being an artful man, dismissed him with a small recompense, requesting that he would not fail to bring him further supplies.

The subterraneous passages of the great mine are so extensive, that it would require several hours to pass through them. The greatest perpendicular depth, computing from the entrance of the shaft, is 840 feet; but as these passages advance horizontally, under a high mountain, the depth would be much greater if the measure were taken from the surface. One mode of descending the shaft is by a bucket; but as the entrance is narrow, the bucket is liable to strike against the sides, or to be stopped by some obstacle, so that it may be readily overset. A second mode of descending is safer, by the means of a great number of ladders, placed obliquely, in a kind of a zig-zag: as the ladders, however, are wet and narrow, a person must be very cautious how he steps to prevent his falling. In the course of the descent, there are several resting places, which are extremely welcome to the wearied traveller. In some of the subterraneous passages the heat is so intense, as to occasion a profuse sweat; and in several of the shafts the air was formerly so confined, that several miners were suffocated by an igneous vapour, or gaseous exhalation, called the fire-damp. This has been prevented by sinking the main shaft deeper. Near to it is a large wheel, and an hydraulic machine, by which the mine is cleared of water.

To these pernicious and deadly caverns criminals are occasionally banished by the Austrian government; and it has sometimes happened that this punishment has been allotted to persons of considerable rank and family. An incident of this nature, in the person of Count Alberti, laid the foundation of Mr. Sargent's elegant dramatic poem entitled "THE MINE."

The Count having fought a duel with an Austrian general, against the Emperor's command, and having left him for dead, was obliged to seek refuge in one of the forests of Istria, where he was apprehended, and afterwards rescued by a band of robbers who had long infested that quarter. With these banditta he spent nine months, until, by a close investiture of the place in which they were concealed, and after a very obstinate resistance, in which the greater part of them were killed, he was taken and carried to Vienna, to be broken alive on the wheel. This punishment was, by the intercession of his friends, changed into that of perpetual confinement and labour in the mines of Idria—a sentence which, to a noble mind, was worse than death. To these mines he was accompanied by the Countess, his lady, who belonged to one of the first families in Germany, and who, having tried every means to procure her husband's pardon without effect, resolved at length to share his miseries, as she could not relieve them. They were terminated, however, by his pardon being procured by the general with whom he had fought the duel, on the latter being recovered from his wounds; and this nobleman, on his return to Vienna, was again taken into favour, and restored to his fortune and rank.

IRON MINES.

NATIVE IRON, the existence of which was formerly questioned, has been found in several places: it is, however, far from being common, and occurs in several mines. A mass of this description of iron was discovered in the district of Santiago del Estero, in South America, by a party of Indians, in the midst of a wide extended plain. It projected about a foot above the ground, nearly the whole of its upper surface being visible; and the news of its having been found in a country where there are not any mountains, nor even the smallest stone, within the circumference of a hundred leagues, was considered as truly surprising. Although the journey was attended with great danger, on account of the want of water, and abundance of wild beasts in these deserts, several individuals, in the hope of gain, undertook to visit this mass; and, having accomplished their journey, sent a specimen of the metal to Lima and Madrid, where it was found to be very pure soft iron.

As it was reported that this mass was the extremity of an immense vein of the metal, a metallurgist was sent to examine the spot, and by him it was found buried in pure clay and ashes. Externally it had the appearance of very compact iron, but was internally full of cavities, as if the whole had been formerly in a liquid state. This idea was confirmed by its having, on its surface, the impression of human feet and hands of a large size, as well as that of the feet of a description of large birds, very common in South America. Although these impressions seemed very perfect, it was concluded, either that they were *lusus naturæ*, or that impressions of this kind were previously on the ground, and that the liquid mass of iron, in falling on it, received them. It had the greatest resemblance to a mass of dough; which, having been stamped with impressions of hands and feet, and marked with a finger, had aferwards been converted into iron.

On digging round the mass, the under surface was found covered with a coat of scoriæ from four to six inches thick, undoubtedly occasioned by the moisture of the earth, the upper surface being clean. Not any appearance of generation was observed in the earth below or round it for a great distance. About two leagues to the eastward was a brackish mineral spring, and a very gentle ascent of from four to six feet in height, running from north to south; with this exception, the adjacent territory was a perfect level. About the spring, as well as near the mass, the earth was very light, loose, and greatly resembling ashes, even in colour. The grass in the vicinity, was very short, small, and extremely unpalatable to the cattle; but that at a distance was long, and extremely grateful to them.—From these concurrent circumstances it was concluded, that this mass of native iron, which was estimated to weigh about three hundred quintals, was produced by a volcanic explosion. It is stated as an undoubted fact, that in one of the forests of the above district of Santiago del Estero, there exists a mass of pure native iron, in the shape of a tree with its branches. At a little depth in the earth are found stones of quartz of a beautiful red colour, which the honey gatherers, the only persons who frequent this rude territory, employ as flints to light their fires. Several of these were selected on account of their peculiar beauty, they being



No. 40.—Silver Mine.



No. 41.—Copper Mine.

spotted and studded, as it were, with gold: one of them, weighing about an ounce, was ground by the governor of the district, who extracted from it a drachm of gold.

A fibrous kind of native iron has been found at Ebenstock in Saxony, and also in Siberia, where one particular mass weighed 1600 pounds. It resembled forged iron in its composition, and was malleable when cold, but brittle when red hot. In Senegal, where it is most common, it is of a cubical form, and is employed by the natives in the manufacture of different kinds of vessels.

Iron, although one of the imperfect metals, is susceptible of a very high polish, and more capable than any other metal of having its hardness increased or diminished by certain chemical processes. It is often manufactured in such a way as to be *one hundred and fifty times*, and, as will now be seen, even above *six hundred and thirty times*, more valuable than gold. On weighing several common watch-pendulum springs, such as are sold, for ordinary work, by the London artists, at half a crown, ten of them were found to weigh but one single grain. Hence one pound avoirdupois, equal to seven thousand grains, contains ten times that number of these springs, which amount, at half a crown each, to 8750 pounds sterling. Reckoning the troy ounce of gold at four pounds sterling, and the pound, equal to 5760 grains, at 48 pounds sterling, the value of an averdupois pound of gold is 58,33, or 58l. 6s. 7d. The above amount of the value of the watch springs weighing an avoirdupois pound, being divided by that sum, will give a ratio of somewhat more than 150 to 1. But the pendulum-springs of the best kind of watches sell at half a guinea each; and at this price the abovementioned value is increased in the ratio of four and one fifth to one; which gives an amount of 36,750l. sterling. This sum being divided by the value of the avoirdupois pound or gold, gives a quotient of more than 630 to 1.

It is the valuable property of iron, after it is reduced into the state of steel, that, although it is sufficiently soft when hot, or when gradually cooled, to be formed without difficulty into various tools and utensils, still it may be afterwards rendered more or less hard, even to an extreme degree, by simply plunging it, when red hot, into cold water. This is called *tempering*, the hardness produced

being greater in proportion as the steel is hotter, and the water colder. Hence arises the superiority of this metal for making mechanics' instruments or tools, by which all other metals, and even itself, are filed, drilled, and cut. The various degrees of hardness given to iron, depend on the quantity of ignition it possesses at the moment of being tempered, which is manifested by the succession of colour exhibited on the surface of the metal, in the progress of its receiving the increasing heat. These are, the yellowish white, yellow, gold-colour, purple, violet, and deep blue;—after the exhibition of which the complete ignition takes place. These colours proceed from a kind of scorification on the surface of the heated metal.

The largest iron works in England are carried on in COLEBROOK DALE, in Shropshire. This spot, which is situated between two towering and variegated hills, covered with wood, possesses peculiar advantages, the ore being obtained from the adjacent hills, the coals from the vale, and abundance of limestone from the quarries in the vicinity. The romantic scenery which nature here exhibits, and the works which are carrying on, seem to realise the ancient fable of the Cyclops. "The noise of the forges, mills, "&c." Mr. Young observes, "with all their vast ma-"chinery, the flames bursting from the furnaces, with the "burning coal, and the smoke of the lime kilns, are "altogether horribly sublime." To complete the peculiarities of this spot, a bridge, entirely constructed of iron, is here thrown over the Severn. In one place it has parted, and a chasm is formed; but such is its firm basis, that the fissure has neither injured its strength nor utility.

The great superiority of Swedish iron over that of all other countries, for the manufacture of steel, is well known, and is ascribed to the great purity of the ore from which the iron is smelted. Hitherto the British steel makers have not been able to employ British iron in their processes, it having been found too brittle to bear cementation; but attempts are now making by some very spirited steel makers at Sheffield; and from the products already obtained, great hopes are entertained of ultimate success. One of the most remarkable of the Swedish mines, if the name can with propriety be applied to it, is Tabera, a mountain of a considerable size, composed entirely of pure iron ore, and

occurring in a large tract of sand over which it seems to have been deposited. This mountain has been wrought for nearly three centuries, notwithstanding which its size is scarcely diminished.

But the richest iron mine of Sweden is that of Danmora, in the province of Upland. It is in depth eighty fathoms; occupies a considerable extent of territory; and its ore is conveyed to the surface of the earth, through several pits or openings made for that purpose, by means of casks fixed to large cables, which are put in motion by horses. The workmen standing on the edges of these casks, and having their arms clasped round the cable, descend and ascend with the utmost composure. The water is drawn from the bottom by a wheel sixty-six feet in diameter, and is afterwards conveyed along an aqueduct nearly a mile and a half in length. At certain distances from Danmora, are several furnaces, with large and populous villages exclusively inhabited by the miners.

In Wraxall's tour through the north of Europe, the mine of Danmora is described as yielding the finest iron ore in Europe, its produce being exported to every country, and constituting one of the most important sources of national wealth and royal revenue. The ore is not dug, as is usual in other mines, but is torn up by the force of gunpowder—an operation which is performed every day at noon, and is one of the most awful and tremendous that can possibly be conceived. "We arrived," observes the tourist, "at the mouth of the great mine, which is nearly "half an English mile in circumference, in time to be "present at it. Soon after twelve the first explosion "took place, and could not be so aptly compared to any "thing as to subterraneous thunder, or rather vollies of "artillery discharged under ground. The stones were "thrown up, by the violence of the gunpowder, to a vast "height above the surface of the ground, and the concussion was so great as to shake the surrounding earth or "rock on every side.

"As soon as the explosion had ceased, I determined "to descend into the mine, to effect which I had to seat "myself in a large deep bucket, capable of containing "three persons, and fastened by chains to a rope. When "I found myself thus suspended between heaven and

"earth by a rope, and looked down into the dark and "deep abyss beneath me, to which I could see no termination, I shuddered with apprehension, and half repented my curiosity. This was, however, only a momentary sensation, and before I had descended a hundred feet, I looked round on the scene with very tolerable composure. It was nearly nine minutes before "I reached the bottom; and when I set my foot on the "earth, the view of the mine was awful and sublime in "the highest degree. Whether, as I surveyed it, terror "or pleasure formed the predominant feeling, is hard to "say. The light of the day was very faintly admitted "into these subterraneous caverns: in many places it was "absolutely lost, and flambeaux were kindled in its stead. "Beams of wood were laid across some parts, from one "side of the rock to the other; and on these the miners sat, "employed in boring holes for the admission of gunpowder, with the most perfect unconcern, although "the least dizziness, or even a failure in preserving their "equilibrium, must have made them lose their seat, and "have dashed them against the rugged surface of the "rock beneath. The fragments torn up by the explosion, "previously to my descent, lay in vast heaps on all sides, "and the whole scene was calculated to inspire a gloomy "admiration.

"I remained three quarters of an hour in these frightful "and gloomy caverns, which find employment for not "less than one thousand three hundred workmen, and "traversed every part of them which was accessible, "conducted by my guides. The weather above was very "warm, but here the ice covered the whole surface of "the ground, and I found myself surrounded with the "colds of the most rigorous winter, amid darkness and "caves of iron. In one of these, which ran a considerable way beneath the rock, were eight wretched beings warming themselves round a charcoal fire, and "eating the little scanty subsistence arising from their "miserable occupation. They rose with surprise at seeing "so unexpected a guest among them, and I was not a "little pleased to dry my feet, which were wet with treading on the melted ice, at their fire.

"Having gratified my curiosity with a view of these

"subterraneous apartments, I made the signal for being "drawn up, and felt so little terror while re-ascending, "compared with that of being let down, that I am convinced, after five or six repetitions, I should have been "perfectly indifferent to the undertaking. So strong is the "effect of custom on the human mind, and so contemptible does danger or horror become, when familiarised by "continual trials!"

Throughout the whole extent of Sweden, the iron mines at present wrought, employ upwards of twenty-five thousand persons, and yield annually upwards of fifty-seven thousand tons of metal. It has been calculated that the furnaces and forges, which give to the iron the degree of perfection requisite before it can be used, consume annually two millions four hundred thousand loads of charcoal.

MINES OF COPPER, TIN, LEAD, &c.

The purest copper obtained in Europe is the produce of the mines of the Swedish province of Delecarlia. The following is a brief description of the principal of these immense and gloomy caverns, all of which boast a high antiquity.

The traveller's curiosity is first attracted by the hydraulic machines which are destined to convey the water to the different quarters, and the power of which is such, that one of the wheels has a diameter of not less than forty-four feet. Another wheel, of proportionate magnitude, is employed to raise the ore from the mine to the surface of the earth, and is admirably constructed. Regular circles are placed on each side, and round these the chain rises, taking a larger or smaller circumference, in proportion to the necessary circle to be made, so as to counterbalance the weight, and consequently the increased motion of the bucket.

Exteriorly, a vast chasm of a tremendous depth presents itself to the view. This being the part of the mine which was first opened, either through the ignorance or neglect of those who had then the management of the works, the excavations so weakened the foundations of the hill, that the whole fell in, leaving a most chaotic scene of precipitated rocks, and a gaping gulf resembling the mouth of a volcano. Great care has been since taken that no such disaster should again occur. Plans and sections are drawn of

all the galleries, &c; and, where the prosecution of the works, in the same direction, might be dangerous, orders are issued for the miners to stop, and AN IRON CROWN is fixed on the spot, as a prohibition ever to proceed further. The workmen then explore in a different direction, while every subterraneous excavation is nicely watched.

The traveller passes into the great chasm by a range of wooden steps, which cross, in a variety of directions, the rough masses of fallen rocks, of gravel, and of the ancient machinery. Ere he reaches the entrance of the cavern, he has to descend thirty toises; and this being accomplished, proceeds horizontally to a considerable distance within. He now loses the pure air of day, and gradually breathes an oppressive vapour, which rolls towards him, in volumes from the mouths of a hundred caves leading into the main passage. He now feels as if he were inhaling the atmosphere of Tartarus. The Swedish iron mines which are described above, are mere purgatories when compared with this Satanic dwelling. The descent is performed entirely by steps laid in the winding rock; and, in following the subterraneous declivity, the traveller reaches the tremendous depths of these truly Stygian dominions.

The pestilential vapours which environ him with increasing clouds, and the style of the entrance, remind him of Virgil's description of the descent of Æneas to the infernal regions. Here are to be seen the same caverned portico, the rocky, rough descent, the steaming sulphur, and all the deadly stenches of Avernus. The wretched inmates of this gloomy cavern appear to him like so many spectres, as poetic fiction has described them: and he is induced by the length of the way, joined to the excessive heat and its suffocating quality, to fancy that he will be made to pay dearly for his curiosity. In one part the steam is so excessively hot as to scorch at the distance of twelve paces, at the same time that the sulphureous smell is intolerable. Near this spot a volcanic fire broke out some years ago, in consequence of which, strong walls were constructed, as barriers to its power, and several contiguous passages, which, had it spread, would have proved dangerous to the mine, closed up.

The visitor has now to traverse many long and winding galleries, as well as large vaulted caverns, where the work-

men are dispersed on all sides, employed in hewing vast masses of the rock, and preparing other parts for explosion. Others wheel the brazen ore towards the black abyss where the suspended buckets hang ready to draw it upward. From the effect of such violent exercise, combined with the heat, they are obliged to work almost naked. Their groupes, occupations, and primitive appearance, scantily lighted by the trembling rays of torches, form a curious and interesting scene.

The depth of the mine being at least twelve hundred feet, a full hour is required to reach to the bottom. The mass of copper lies in the form of an inverted cone. Five hundred men are employed daily: but females are not admitted, on account of the deleterious quality of the vapours.

This mine was anciently a state prison, in which criminals, slaves, and prisoners of war toiled out their wretched existence. Near the bottom is a rocky saloon furnished with benches. It is called the HALL OF THE SENATE, on account of its having been the resting place of several Swedish Kings, who came, attended by the senators, to examine the works, and here took refreshments. It was in this mine that the immortal GUSTAVUS VASA, disguised as a peasant, laboured for his bread, in the course of a long concealment, after having been robbed by the peasant who served him as a guide.

In the year 1751, a very rich copper mine was wrought in the county of WICKLOW, IRELAND. From this mine ran a stream of blue-coloured water, of so deleterious a nature as to destroy all the fish in the river Arklow, into which it flowed. One of the workmen, having left an iron shovel in this stream, found it some days after encrusted with copper. This led one of the proprietors of the mine to institute a set of experiments, from which he concluded that the blue water contained an acid holding copper in solution; that iron had a stronger affinity for the acid than copper; and that the consequence of this affinity was the precipitation of the copper, and the solution of the iron, when pieces of that metal were thrown into the blue water. These ideas induced the miners to dig several pits for the reception of this water, and to put bars of iron into them. The result was, that they obtained an abun-

dance of copper, much purer and more valuable than that which they procured from the ore itself by smelting.

On the island of ANGLESEA, near Dulas bay, on the north coast, is PARYS MOUNTAIN, which contains the most considerable quantity of copper ore perhaps ever known. The external aspect of the hill is extremely rude, and it is surrounded by enormous rocks of coarse white quartz. The ore is lodged in a basin, or hollow, and has on one side a small lake, over the waves of which, as over those of Avernus, fatal to the feathered tribe, birds are never known to pass. The effect of the mineral operations has been, that the whole of this tract has assumed a most savage appearance. Suffocating fumes of the burning heaps of copper arise in all parts, and extend their baneful influence for miles around. That the ore was worked in a very remote period, appears by vestiges of the ancient operations, which were carried on by trenching, and by heating the rocks intensely, when water was suddenly poured on them, so as to cause them to crack or scale. In the year 1768, after a long search, which was so little profitable that it was on the eve of being abandoned, a large body of copper ore was found; and this has ever since been worked to great advantage, still promising a vast supply. The water lodged in the bottom of the bed of ore, being strongly impregnated with the metal, is drawn up and distributed in pits, where the same process is employed as in the Wicklow mine. The copper thus procured differs little from native copper, and is very highly prized.

In the Parys mine eight tons of gunpowder are annually expended in blasting the rock. Nature has here been profuse in bestowing her mineral favours; for, above the copper ore, and not more than two feet beneath the soil, is a bed of yellowish greasy clay, from three to twelve feet in thickness, containing lead ore, from a ton of which metal upwards of fifty ounces of silver are generally obtained. These works have added greatly to the population of the country, since they find employment for about fifteen hundred persons, who, with their families, are supposed to amount to eight thousand souls, all of them deriving their subsistence from the mines.

The copper mines of CORNWALL are very numerous,

and several of them large and rich in ore. It is remarkable that in various parts of this country the earth has produced such an exuberance of this metal, as to afford it in large massy lumps of malleable copper, several pieces of which are shewn in very curious vegetable forms. The particular ore named *mundic*, found in the tin mines, was for many ages considered of no other use but to nourish that metal while in the mine. In the reign of Queen Elizabeth, a laudable curiosity tempted several private individuals to examine into its nature; but the design miscarried, and the mundic was thrown, as useless, into the old pits in which the rubbish was collected. However, about a century ago, this purpose was effected by degrees; and the copper extracted from the ore now produces, on an average, upwards of one hundred and fifty thousand pounds annually, equalling in goodness the best Swedish copper, while the ore itself yields a proportionate quantity of *lapis calaminaris* for the making of brass.

At Ecton hill, near the river Dove, in Derbyshire, a valuable copper mine was discovered some years ago, and has since been worked to great advantage. In its position, situation, and inclination, it differs from any mine yet discovered in Europe, Asia, Africa, or America; the wonderful mass of copper ore not running in regular veins or courses, but sinking perpendicularly down, widening and swelling out at the bottom in the form of a bell. The works are four hundred and fifty feet beneath the river Dove, it being the deepest mine in Great Britain. On the opposite side of Ecton hill is a valuable lead mine, the veins of which approach very nearly to the copper mine.

Copper is converted into brass by the agency of Calamine, an oxide of zinc. It occurs frequently in beds, and in some places exists in great abundance. The Mendip hills, in Somersetshire, were once celebrated for their mines of calamine, which are now in a great measure exhausted. It is dug out of the earth, and, being broken into small pieces, is exposed to the action of a current of water, which washes away the light earthy matter, and leaves the calamine. The whole is then thrown into deep wooden vessels filled with water, and agitated for a considerable time. The galena sinks to the bottom, the calamine is deposited in the centre, and the earthy matter lies on the surface.

The calamine, thus separated from its imperities, is ground to powder, and becomes fit for use.

HUNGARY abounds in valuable ores and minerals, and is most celebrated for its vast copper works, at a town called Herrengrund, built on the summit of a mountain, and exclusively inhabited by miners. Here the process, noticed above, of apparently converting iron into copper, is pursued with great success, several hundred weight of iron being thus transmuted every year. The vitriol with which the blue water is strongly impregnated, cannot be strictly said to convert the iron into copper, but insinuates into it the copper particles with which it is saturated; and this seeming transmutation requires a fornight or three weeks only: but if the iron be suffered to lie too long in this vitriolic solution, it becomes at length reduced to powder.

In JAPAN, copper is the most common of all the metals, and is considered as the finest and most malleable any where to be found. Much of this copper is not only of the purest quality, but is blended with a considerable proportion of gold, which the Japanese separate and refine. The whole is brought to Saccia, one of the five principal cities of Japan; and it is there purified, and cast into small cylinders, about a span and a half in length, and a finger's breadth in thickness. Brass is there very scarce, and much dearer than copper, the calamine employed in making it being imported from Tonquin in flat cakes, and sold at a very high price.

CORNWALL has been in all ages, famous for its numerous mines of tin, which are in general very large, and rich in ore. The tin-works are of different kinds, dependent on the various forms in which the metal appears. In many places its ore so nearly resembles common stones, that it can only be distinguished from them by its superior weight. In other parts, the ore is a compound of tin and earth, concreted into a substance almost as hard as stone, of a bluish or greyish colour, and to which the mundic, impregnated with copper, frequently gives a yellowish cast. This ore is always found in a continued stratum, which the miners call *load;* and this, for the greater part, is found running through the solid substance of the hardest rocks, beginning in small veins near the surface, perhaps not above half an inch or an inch wide, and increasing, as

they proceed, into large dimensions, branching out into several ramifications, and bending downward in a direction which is, generally, nearly east and west. These loads, or veins, are sometimes white, very wide, and so thick, that large lumps of the ore are frequently drawn up of more than twenty pounds weight. The loads of tin-ore are not always contiguous, but sometimes break off so entirely, that they seem to terminate; but the sagacious miner knows by experience, that, by digging at a small distance on one side, he shall meet with a separated part of the load, apparently tallying with the other end, as nicely as if it had been broken off by some sudden shock of the rock.

The miners of Cornwall follow the load, or vein, in all its rich and meandering curves through the bowels of the flinty earth. The waters are sometimes drained from the mines, by subterraneous passages, formed from the body of the mountain to the level country. These passages are called *adits*, and are occasionally the labour of many years; but when effected, they save the constant expense of large water works and fire-engines. From the surface of the earth the workmen sink a passage to the mine, which they call a shaft, and place over it a large winch, or, in works of greater magnitude, a wheel and axle, by which means they draw up large quantities of ore at a time, in vessels called *kibbals*. This ore is thrown into heaps, which great numbers of poor people are employed in breaking to pieces, and fitting the ore for the stamping mills.

A third form in which tin appears is that of crystals; for this metal will under proper circumstances, readily crystalize. Hence, in many parts of the mineral rocks, are found the most perfectly transparent and beautiful crystals of pure tin. Beside these crystals, in many of the cavernous parts of the rocks, are found those transparent crystals, called CORNISH DIAMONDS, they being extremely brilliant when well polished. The form is that of a six-sided prism pointed on the top, and they are sometimes four or five inches in length.

Among the most remarkable LEAD MINES, may be cited those of UPPER LOUISIANA, in NORTH AMERICA, which have for many years been highly productive. That called Burton's mine is so extensive, that the mineral is calculated

to cover two thousand acres of land. It is of two kinds, the gravel and fossil. The gravel mineral is found immediately under the soil, intermixed with gravel, in pieces of solid mineral weighing from one to fifty pounds. Beneath the gravel is a sand rock, which being broken, crumbles to a fine sand, and contains mineral nearly of the same quality as that of the gravel. But the mineral of the first quality is found in a bed of red clay, under the sand rock, in pieces of from ten to five hundred pounds weight, on the outside of which is a spar, or fossil, of a bright glittering appearance, resembling spangles of gold and silver, as solid as the mineral itself, and of a greater specific gravity. This being taken off, the mineral is solid, unconnected with any other substance, of a broad grain, and what mineralogists call potters' ore.

In other mines, in the vicinity of the above, the lead is found in regular veins, from two to four feet in thickness, containing about fifty ounces of silver in a ton; but at the depth of twenty five feet the operations are impeded by water. The whole of this mineral tract is very rich and extensive.

In GREAT BRITAIN there are numerous lead mines, among which may be cited that of Arkingdale, in Yorkshire, and those with which Shropshire abounds. In the south of Lanerkshire, and in the vicinity of Wanlock-head, Scotland, are two celebrated lead mines, which yield annually above two thousand tons of metal. The Susannah-vein Lead-hills, has been worked for many years, and has been productive of great wealth. The above are considered as the richest lead mines of Europe.

Several of the Irish lead mines have yielded a considerable proportion of silver; and mention is made of one, in the county of Antrim, which afforded, in thirty pounds of lead, a pound of that metal. Another, less productive of silver, was found at Ballysadare, near the harbour of Sligo in Connaught; and a third in the county of Tipperary, thirty miles from Limerick. The ores of this last were of two kinds, most usually of a reddish colour, hard and glittering; the other, which was the richest in silver, resembled a blue marl. The works were destroyed in the Irish insurrections in the reign of Charles I. The mine, however, is still wrought on account of the lead it contains.

The following is the enumeration of the different substances in which metals are found. In granitic mountains, tin, lead, iron, zinc, bismuth, cobalt; and in gneifs, or schistose granite, silver, copper, lead, tin, and zinc. In micaceous schist are found copper, tin, lead, and antimony. In hornblende slate, copper ore; and under argillate, or common slate, silver, copper, lead, and zinc. In steatite sulphureous pyrites, and magnet. In primitive lime-stone copper, lead, and zinc appear; and even in a strata of coal, native silver, galena, and manganese have been discovered.

COAL MINES.

COALS are scattered, with a more or less sparing hand, over every continent, and almost over every kingdom of the globe; but there is not any country where coal mines are so rich and so frequent as in Great Britain, the opulence of which has been principally ascribed to this valuable mineral.

It is, in truth, the very soul of her manufactures, and consequently of her commerce, every manufacturing town being established in the midst of a coal country. Of this striking instances are afforded by Bristol, Birmingham, Wolverhampton, Sheffield, Newcastle, and Glasgow.

The coals of Whitehaven and Wigan are esteemed the purest; and the cannel and peacock coals of Lancashire are so beautiful, that they are suspected by some to have constituted the *gagates*, or jet, which the ancients ascribed to Great Britain. In Somersetshire, the Mendip coal-mines are distinguished by their productiveness: they occur there, as indeed in every other part, in the low country, and are not to be found in the hills. The beds of coal are not horizontal, but sloping, dipping to the south-east at the rate of about twenty two inches per fathom. Hence they would speedily sink so deep that it would not be possible to work them, were it not that they are intersected at intervals by perpendicular dykes or veins, of a different kind of mineral, on the other side of which these beds are found considerably raised up. They are seven in number, lying at regular distances beneath each other, and separated by beds of a different kind of substance, the deepest being placed more than two hundred feet beneath the surface of the earth.

The town of Newcastle, in Northumberland, has been

celebrated during several centuries for its very extensive trade in coals. It was first made a borough by William the Conqueror, and the earliest charter for digging coals, granted to the inhabitants, was in the reign of Henry III. in 1239; but in 1306, the use of coal for fuel was prohibited in London, by royal proclamation, chiefly because it injured the sale of wood, with which the environs of the Capital were then overspread. This interdict did not, however, continue long in force; and coals may be considered as having been dug for exportation at Newcastle for more than four centuries. It has been estimated that there are twenty-four considerable collieries lying at different distances from the river, from five to eighteen miles; and that they produced, for an average of six years, up to the close of 1776, an annual consumption of three hundred and eighty thousand chaldrons, Newcastle measure, (equal to seven hundred and seventeen thousand six hundred and fifteen chaldrons, London measure) of which about thirty thousand chaldrons were exported to foreign parts. The boats employed in the colliery are called keels, and are described as strong, clumsy, and oval, each carrying about twenty tons; and of these four hundred and fifty are kept constantly employed. In the year 1776 an estimate was made of the shipping employed in the Newcastle coal trade; and from this estimate it appears, that three thousand, five hundred, and eighty-five ships, were during that year engaged in the coasting trade, and three hundred and sixty-three in the trade to foreign ports, their joint tonnage amounting to seven hundred and thirty-eight thousand, two hundred and fourteen tons.

It is a common opinion among geologists, that pit coal is of vegetable origin, and that it has been brought to its present state by the means of some chemical process, not at this time understood. However extravagant this opinion may at first sight appear, it is supported by the existence of vast depositions of matter, half way, as it were, between perfect wood and perfect pit coal; which, while it obviously betrays its vegetable nature, has in several respects so near an approximation to pit coal, as to have been generally distinguished by the name of coal. One of the most remarkable of these depositions exists in Devonshire, about thirteen miles south-west of Exeter, and is well

known under the name of Bovey coal. Its vegetable nature has been ascertained by Mr. Hatchet, in a set of experiments in which he found both extractive matter and resin —substances which belong to the vegetable kingdom.

The beds of this coal are seventy feet in thickness, and are interspersed by beds of clay. On the north side they lie within a foot of the surface, and dip south at the rate of about twenty inches per fathom. The deepest beds are the blackest and heaviest, and have the closest resemblance to pit coal, while the upper ones strongly resemble wood, and are considered as such by those who dig them. They are brown, and become extremely friable when dry, burning with a flame similar to that of wood, and assuming the appearance of wood which has been rendered soft by some unknown cause, and, while in that state, has been crushed flat by the weight of the incumbent earth. This is the case, not only with the Bovey coal, but also with all the beds of wood coal which have been hitherto examined in different parts of Europe.

The coal mines of Whitehaven may be considered as the most extraordinary in the known world. They are excavations which have in their structure, a considerable resemblance to the gypsum quarries of Paris, and are of such a magnitude and extent, that in one of them alone, a sum exceeding half a million sterling, was, in the course of a century, expended by the proprietors. Their principal entrance is by an opening at the bottom of a hill, through a long passage, hewn in the rock, leading to the lowest vein of coal. The greater part of this descent is through spacious galleries, which continually intersect other galleries, all the coal being cut away, with the exception of large pillars, which, where the mine runs to a considerable depth, are nine feet in height, and about thirty-six feet square at the base. Such is the strength there required to support the ponderous roof.

The mines are sunk to the depth of one hundred and thirty fathoms, and are extended under the sea to places where there is, above them, sufficient depth of water for ships of large burden. These are the deepest coal mines which have hitherto been wrought; and perhaps the miners have not in any other part of the globe penetrated to so great a depth beneath the surface of the sea, the very deep

mines in Hungary, Peru, and elsewhere, being situated in mountainous countries, where the surface of the earth is elevated to a great height above the level of the ocean.

In these mines there are three strata of coal, which lie at a considerable distance one above the other, and are made to communicate by pits; but the vein is not always continued in the same regularly-inclined plane, the miners frequently meeting with hard rock, by which their further progress is interrupted. At such places there seem to have been breaks in the earth, from the surface downward, one portion appearing to have sunk down, while the adjoining part has preserved its ancient situation. In some of these places the earth has sunk ten, twenty fathoms, and even more; while in others the depression has been less than one fathom. These breaks the miners call dykes; and when they reach one of them, their first care is to discover whether the strata in the adjoining part are higher or lower than in the part where they had been working; or, according to their own phrase, whether the coal be cast down or cast up. In the former case they sink a pit; but if it be cast up to any considerable height, they are frequently obliged, with great labour and expense, to carry forward a level, or long gallery, through the rock, until they again reach the stratum of coal.

Coal, the chief mineral of Scotland, has been there worked for a succession of ages. Pope Pius II. in his description of Europe, written about 1450, mentions that he beheld with wonder black stones given as alms to the poor of Scotland. This mineral may, however, be traced to the twelfth century; and a very early account of the Scottish coal mines, explains with great precision, the manner of working the coal, not neglecting to mention the subterraneous walls of whin which intersect the strata, particularly a remarkable one, visible from the river Tyne, where it forms a cataract, and passes by Prestonpans, to the shore of Fife. The Lothians and Fifeshire, particularly abound with this useful mineral, which also extends into Ayrshire; and near Irwin is found a curious variety, named ribbon coal. A singular coal, in veins of mineral, has been found at Castle Leod, in the east of Rosshire; and it is conjectured that the largest untouched field of coal in Europe, exists in a barren tract of country in Lanerkshire.

In North America, coal has been discovered in great

abundance on both sides of James river, and is said to have been first discovered by a boy in pursuit of cray fish. This valuable mineral also abounds towards the Mississippi and the Ohio, that of Pittsburgh being of a superior quality; but it is chiefly worked in Virginia, where the beds are very extensive. One of these beds, about twenty-four feet in thickness, was found to repose on granite, and is cited as a great singularity. In the territory south of the Ohio, what is called stone coal is found in the Cumberland mountains; and in 1804 a coal mine was discovered on the river Juniata, in the vicinity of the Apalachian mountains. The bed is horizontal, on which account it is wrought with considerable advantage, and the mineral is upwards of ten feet in thickness. Notwithstanding these supplies at particular points of the extensive territory of the United States, coals are imported from Great Britain in very considerable quantities. In the space of one year, reckoning from the first of October, 1801, the importation amounted to not less than 18,473 chaldrons.

The process of mining is a combination of boring and digging. Shafts are sunk, levels are driven, and drains are carried off, by the help of picks or pick-axes, wedges, and hammers, the rocks being also sometimes loosened by blasting with gunpowder. In searching for coal, a shaft is sunk through the uppermost soft stratum, and the rock is then bored, by striking it continually with an iron borer terminating in an edge of steel, which is in the mean time turned partly round; and, at proper intervals, a scoop is let down to draw up the loose fragments. In this manner a perforation is sometimes made for more than an hundred fathoms, the borer being lengthened by pieces screwed on; it is then partly supported by a counterpoise, and worked by machinery. Should it happen to break, the piece is raised by a rod furnished with a hollow cone, as an extinguisher, which is driven down on it. The borer is sometimes furnished with knives, which are made to act on any part at pleasure, and to scrape off a portion of the surrounding substance, which is collected in a proper receptacle.

Those who have the direction of deep and extensive coal mines, are obliged, with great art and care, to keep them ventilated with perpetual currents of fresh air, which afford the miners a constant supply of that vital fluid, and expel

from the mines damps and other noxious exhalations, together with such other burnt and foul air, as is become deleterious and unfit for respiration. In the deserted mines, which are not thus ventilated with currents of fresh air, large quantities of these damps are frequently collected; and in such works, they often remain for a long time without doing any mischief. But when, by some accident they are set on fire, they then produce dreadful explosions, and, bursting out of the pits with great impetuosity, like the fiery eruptions from burning mountains, force along with them ponderous bodies to a great height in the air.

Various instances have occurred in which the coal has been set on fire by the fulminating damp, and has continued burning for several months, until large streams of water were conducted into the mine, so as to inundate the parts where the conflagration existed. By such fires several collieries have been entirely destroyed, in the vicinity of Newcastle, and in other parts of England as well as in Fifeshire in Scotland. In some of these places the fire has continued to burn for ages. To prevent, therefore, as much as possible, the collieries from being filled with these pernicious damps, it has been found necessary carefully to search for the crevices in the coal whence they issue, and, at those places, to confine them within a narrow space, conducting them through large pipes into the open air, where, being set on fire, they consume in perpetual flame as they continually arise out of the earth.

The late Mr. Spelling, engineer of the Whitehaven coal mines, having observed that the fulminating damp could only be kindled by flame, and that it was not liable to be set on fire by red-hot iron, nor by the sparks produced by the collision of flint and steel, invented a machine called a steel-mill, in which a wheel of that metal is turned round with a very rapid motion, and, by the application of flints, great plenty of sparks are emitted, which afford the miners such a light as enables them to carry on their work in close places, where the flames of candle, or of a lamp, would, as has already happened in various instances, occasion violent explosions. In that dreadful catastrophe, the explosion of the Felling Colliery, the particulars of which will be hereafter detailed, it will be seen that mills of this description were employed, in searching for the remains of

the sad victims of the disaster; but this event happened before the invention of Sir Humphrey Davy's safety lamp, a discovery which, while it affords a more certain light, holds out every security to the miner against accidents which, without such a resource, might still be superadded to those already recorded, as arising from the flame of a candle or lamp.

A greater number of mines have, however, been ruined by inundations than by fires; and here that noble invention the fire-engine displays its beneficial effects. It appears from nice calculations, that it would require about 550 men, or a power equal to that of 110 horses, to work the pumps of one of the largest fire-engines, having a cylinder of seventy inches diameter, now in use, and thrice that number of men to keep an engine of that size constantly at work. It also appears that as much water may be raised by such an engine, as can be drawn, within the same space of time, by 2520 men with rollers and buckets, after the manner now daily practised in many mines; or as much as can be bourne on the shoulders of twice that number of men, as is said to be done in several of the mines of Peru. So great is the power of the elastic steam of the boiling water in those engines, and of the outward atmosphere, which, by their alternate actions, give force and motion to the beam, and, through it, to the pump rods which elevate the water through tubes, and discharge it from the mine!

There are four fire-engines belonging to the Whitehaven colliery, which when all at work, discharge from it about 1228 gallons of water every minute, at thirteen strokes; and at the same rate, 1,768,320 gallons, upwards of 7000 tons, every twenty-four hours. By these engines nearly twice the above-mentioned quantity of water might be discharged from mines which are not above sixty or seventy fathoms deep, which depth is rarely exceeded in the Newcastle collieries, or in any other English collieries, with the exception of the above.

Coal pits have some times taken fire by accident, and have continued to burn for a considerable length of time. About the year 1648, a coal mine at Benwell, a village near Newcastle-upon-Tyne, was accidentally kindled by a candle: at first, the fire was so feeble, that a reward of half a crown, which was asked by a person who offered to ex-

tinguish it, was refused. It gradually increased, however, and had continued burning for thirty years, when the account was drawn up and published in the Philosophical Transactions: it was not finally extinguished until all the fuel was consumed. Examples of a similar kind have happened in Scotland and in Germany.

FELLING COLLIERY.

But of all the recorded accidents relative to coal mines, that of Felling Colliery, near Sunderland, a concise narrative of which here follows, was the most disastrous.

FELLING is a manor about a mile and a half east of Gateshead. It contains several strata of coal, the uppermost of which were extensively wrought in the beginning of the last century. The stratum called the High-main, was won in 1779, and continued to be wrought till the 19th January, 1811, when it was entirely excavated. The present colliery is in the seam called the Low-main. It commenced in October, 1810, and was at full work in May, 1812. This mine was considered by the workmen as a model of perfection in the purity of its air, and orderly arrangements—its inclined plane was saving the daily expense of at least 13 horses—the concern wore the features of the greatest possible prosperity, and no accident, except a trifling explosion of fire-damp slightly burning two or three workmen, had occurred. Two *shifts* or sets of men were constantly employed, except on Sundays. Twenty-five acres of coal had been excavated. The first shift entered the mine at 4 o'clock A. M. and were relieved at their working posts by the next at 11 o'clock in the morning. The establishment it employed under-ground, consisted of about 128 persons, who, from the 11th to the 25th of May, 1812, wrought 624 scores of coal, equal to 1300 Newcastle chaldrons, or 2455 London chaldrons.

About half past 11 o'clock on the morning of the 25th of May, 1812, the neighbouring villages were alarmed by a tremendous explosion in this colliery. The subterraneous fire broke forth with two heavy discharges from the Low-main, which were almost instantaneously followed by one from the High-main. A slight trembling as from an earthquake, was felt for about half a mile around the workings; and the noise of the explosion, though dull, was

heard to three or four miles distance, and much resembled an unsteady fire of infantry.

Immense quantities of dust and small coal accompanied these blasts, and rose high into the air, in the form of an inverted cone. The heaviest part of the ejected matter, such as corves, pieces of wood, and small coal, fell near the pits; but the dust, borne away by a strong west wind, fell in a continued shower from the pit to the distance of a mile and a half. As soon as the explosion was heard, the wives and children of the workmen ran to the pit; the scene was distressing beyond the power of description.

Of one hundred and twenty-eight persons in the mine at the time of the explosion, only thirty-two were brought to day-light, twenty-nine survived the fatal combustion, the rest were destroyed. Nor from the time of the explosion till the 8th of July, could any person descend. But after many unsuccessful attempts to explore the burning mine, it was re-closed, to prevent the atmospheric air from entering it; this being done, no attempt was afterwards made to explore it, till the morning of the last mentioned day; from which time to the 19th of September, the heart-rending scene of mothers and widows examining the putrid bodies of their sons and husbands, for marks by which to indentify them, was almost daily renewed; but very few of them were known by any personal mark, they were too much mangled and scorched to retain any of their features. Their clothes, tobacco-boxes, shoes, &c. were, therefore, the only indexes by which they could be recognised.

At the crane twenty-one bodies lay in ghastly confusion: some like mummies, scorched as dry as if they were baked. One wanted its head, another an arm. The scene was truly frightful. The power of fire was visible upon them all; but its effects were extremely variable: while some were almost torn to pieces, there were others who appeared as if they had sunk down overpowered by sleep.

The ventilation concluded on Saturday the 19th of September, when the ninety-first body was dug from under a heap of stones. At six o'clock in the morning the pit was visited by candle-light, which had not been used in it for the space of one hundred and seventeen days; and at 11 o'clock in the morning the tube furnace was lighted. From this time the colliery has been regularly at work; but the

ninety-second body has never yet been found. All these persons, except four, who were buried in single graves, were interred in Heworth Chapel-yard, in a trench, side by side, two coffins deep, with a partition of brick and lime between every four coffins.

MISCELLANEOUS SUBJECTS CONNECTED WITH MINERALOGY.

CLIFTON HOT-WELL.

The warm spring, or fountain, called THE HOT-WELL, in the parish of Clifton, is said to be so copious as to discharge sixty gallons of water in a minute. It rises forcibly from an aperture in the solid rock, at about twenty-six feet below high-water mark, and ten feet above low-water. On its immediate influx from the rock, the water is much warmer than when it is pumped up for drinking; and it also feels and tastes warmer in winter than in summer, and in very cold days heats the glass into which it falls from the cock. In 1695, this celebrated spring, after having fallen into neglect, was recovered, and the Hot-well-house erected, proper foundations being made for the pumps, by which the water is raised to the height of thirty feet: pipes are contrived, through which the waste water runs into the river; and in these pipes are valves, which open to let out the water, but shut when the tide is rising.

With respect to the qualities of this mineral water, it is natural to suppose that in its subterraneous passage through the rocks, over different strata, and among such variety of mineral and other substances, it must be impregnated with their several virtues. In the common spring water of the neighbouring rock-house, on a trial being made, the mercury in Fahrenheit's thermometer stood at fifty degrees, while that of the Hotwell, taken immediately from the pump, raised it to seventy-six degrees; and as the heat of a person in health seldom exceeds the ninety-sixth degree, it follows, that the Bristol water possesses somewhat more than three-fourths of the human heat.

Below the Hotwell-house rises a magnificent range of

rocks, which are not more remarkable for their height, than for their being equally so on both sides the river, the strata in some places answering on each side for about a mile and a half in a serpentine course. These constitute one of the greatest natural curiosities in England. The rock beyond the Hotwell, and on the same side, is named St. Vincent's, a chapel dedicated to that saint having been formerly built on its summit. It is in height three hundred feet, and has a majestic appearance. It supplies the naturalist with many curious fossils; the botanist with a variety of scarce plants; the antiquary with the remains of a Roman camp; and the less curious enquirer with a view of a most dreadful and surprising precipice.

The rocks in general, when broken up, are of a dusky red, brown, or chocolate colour marble, very hard and close grained, and which, on being struck with a hammer, emit a strong sulphureous smell. It will bear a polish equal to any foreign marble; and, when sawed into slabs and polished, appears beautifully variegated with veins of white, blueish grey, or yellow. It is often employed for chimney-pieces; but is principally used for making lime, for which purpose there is not any stone in England so well calculated, nor is there any lime so strong, fine, and white, which excellent qualities occasion great demand for foreign consumption.

Here, and in the vicinity, labourers are daily employed in blowing up the rocks with gunpowder, by which process vast fragments are frequently thrown down, and repeatedly strike the precipice with a dreadful crash, which, combined with the loud report of the explosion, re-echoed from side to side by the lofty cliffs, makes a grand and awful noise resembling thunder, for which it is frequently mistaken by strangers. It is the opinion of the greater part of those who have viewed these rocks, that they were once united, and were separated by some terrible convulsion of nature. A bridge of one arch, from rock to rock, over the Avon, has long been in contemplation; but if the blowing up of these rocks should still be persisted in, the design will be rendered impracticable. This is the more to be regretted, because stone of the same quality is to be procured in Durham-down, or lower down the river.

In the fissures and cavities of these rocks are found those

fine crystals called BRISTOL STONES, OR DIAMONDS, some of which are so hard as to cut glass, and are exceedingly clear, colourless, and brilliant. When set in rings, in their natural state, these have appeared of as high a polish and lustre as if they had been wrought by the most skilful lapidary.

Bristol is surrounded by coal-pits, those of Gloucestershire being at Kingswood, and those of Somerset at Bedminster, Ashton, Nailsea, and Brislington. But the most copious supply is from Kingswood, where there are a great number of pits and colliers' houses, which last are so frequent, that Kingswood, viewed from the neighbouring hills, has the appearance of being one vast rural suburb of Bristol.

DIAMONDS AND PRECIOUS STONES.

IN addition to the information relative to DIAMOND MINES, at p. 259, *et seq.* of this work, the reader will not fail to be gratified by some curious particulars relative to these and the other more precious gems, drawn from the valuable treatise of Mr. Mawe, on this interesting subject.

In the history of the human race, there are few things which at first sight appear so remarkable, as the prodigious value which, by common consent, in all ages, and in all civilized countries has been attached to the diamond. That a house with a large estate, the means of living, not only at ease but in splendour, should be set in competition with, and even be deemed inadequate to the purchase of a transparent crystallized stone, not half the size of a hen's egg seems almost a kind of insanity. It would, indeed, truly deserve this name, if the purchaser were to part with what the seller would acquire by such a transfer. If, for the consciousness of possessing a diamond of nearly three-quarters of an ounce weight, a country gentleman were to pay ninety thousand pounds in ready money, and an annuity of four thousand pounds besides, he would very deservedly, incur some risk of a statute of lunacy; yet, not only the above sum was given, but a patent of nobility into the bargain, by the Empress Catharine of Russia, for the famous diamond of Nadir Shah. In this case, however, although the seller acquired much, the purchaser did not undergo any personal privation; and, in reality, notwith-

standing the costliness and high estimation of diamonds, they are not put in competition with the substantial comforts and conveniences of *life*. Among ornaments and luxuries, they, however, unquestionably occupy, and have ever occupied, the highest rank. Even fashion, proverbially capricious as she is, has remained steady in this, one of her earliest attachments, during, probably, three or four thousand years. There must be, therefore, in the nature of things, some adequate reason for this universal consent, which becomes a curious object of enquiry.

The utility of the diamond, great as it is in some respects, enters for little or nothing into the calculation of its price; at least all that portion of its value which constitutes the difference between the cost of an entire diamond and an equal weight of diamond powder, must be attributed to other causes.

The beauty of this gem, depending on its unrivalled lustre, is, no doubt, the circumstance which originally brought it into notice, and still continues to uphold it in the public estimation; and certainly, notwithstanding the smallness of its bulk, there is not any substance, natural or artificial, which can sustain any comparison with it in this respect. The vivid and various refractions of the opal, the refreshing tints of the emerald, the singular and beautiful light which streams from the six-rayed star of the girasol, the various colours, combined with high lustre, which distinguish the ruby, the sapphire, and the topaz, beautiful as they are on a near inspection, are almost entirely lost to a distant beholder; whereas the diamond, without any essential colour of its own, imbibes the pure solar ray, and then reflects it, either with undiminished intensity, too white and too vivid to be sustained for more than an instant by the most insensible eye, or decomposed by refraction into those prismatic colours which paint the rainbow, and the morning and evening clouds, combined with a brilliancy which yields, and hardly yields, to that of the meridian sun. Other gems, inserted into rings and bracelets, are best seen by the wearer; and, if they attract the notice of the bystanders, divide their attention, and withdraw those regards which ought to be concentred on the person, to the merely accessary ornaments. The diamond, on the contrary, whether blazing on the crown of

state, or diffusing its starry radiance from the breast of titled merit, or "in courts of feasts and high solemnities," wreathing itself with the hair, illustrating the shape and colour of the neck, and entering ambitiously into contest with the lively lustre of those eyes that "rain influence" on all beholders, blends harmoniously with the general effect, and proclaims to the most distant ring of the surrounding crowd, the person of the monarch, of the knight, or of the beauty.

Another circumstance tending to enhance the value of the diamond is, that although small stones are sufficiently abundant to be within the reach of moderate expenditure, and therefore afford, to all those who are in easy circumstances an opportunity to acquire a taste for diamonds, yet those of a larger size are, and ever have been, rather rare; and of those which are celebrated for their size and beauty, the whole number, at least in Europe, scarcely amounts to half a dozen, all of them being in possession of sovereign princes. Hence, the acquisition even of a moderately large diamond, is what mere money cannot always command; and many are the favours, both political and of other kinds, for which a diamond of a large size, or of uncommon beauty, may be offered as a compensation, where its commercial price, in money, neither can be tendered, nor would be received. In many circumstances also, it is a matter of no small importance for a person to have a considerable part of his property in the most portable form possible; and in this respect what is there that can be compared to diamonds which possess the portability, without the risk, of bills of exchange? It may further be remarked, in favour of this species of property, that it is but little liable to fluctuation, and has gone on pretty regularly increasing in value, insomuch that the price of stones of good quality is considerably higher than it was some years ago.

The art of cutting and polishing diamonds has a twofold object; first, to divide the natural surface of the stone in a symmetrical manner, by means of highly-polished polygonal planes, and thus to bring out, to the best advantage, the wonderful refulgence of this beautiful gem; and, secondly, by cutting out such flaws as may happen to be near the surface, to remove those blemishes which materially detract from its beauty, and consequently from its value.

The removal of flaws is a matter of great importance, for, owing to the form in which the diamond is cut, and its high degree of refrangibility, the smallest fault is magnified, and becomes obtrusively visible in every face. For this reason also, it is by no means an easy matter, at all times, to ascertain whether a flaw is, or is not, superficial; and a person with a correct and well practised eye, may often purchase to great advantage stones which appear to be flawed quite through, but are, in fact, only superficially blemished.

The most esteemed, and, at the same time, nearest colour of the ORIENTAL RUBY, is pure carmine, or blood red of considerable intensity, forming, when well polished, a blaze of the most exquisite and unrivalled tint. It is, however, more or less pale, and mixed with blue in various proportions: hence it occurs rose-red and reddish-white, crimson, peach-blossom-red, and lilac-blue, the latter variety being named ORIENTAL AMETHYST. It is a native of Pegu, and is said to be found in the sand of certain streams near the town of Sirian, the capital of that country: it also occurs, with sapphire, in the sands of the rivers of Ceylon. A ruby perfect both in colour and transparency, is much less common than a good diamond, and when of the weight of three or four carats, is even more valuable than that gem. The King of Pegu, and the monarchs of Ava and Siam, monopolize the finest rubies, in the same way as the Sovereigns of India make a monopoly of diamonds. The finest ruby in the world is in possession of the first of these Kings; its purity has passed into a proverb, and its worth, when compared with gold, is inestimable. The Subah of the Decan, also, is in possession of a prodigiously fine one, a full inch in diameter. The princes of Europe cannot boast of any of a first rate magnitude.

The ORIENTAL SAPPHIRE ranks next in value to the ruby: when perfect, its colour is a clear and bright Prussian blue, united to a high degree of transparency. The ASTERIAS, or STAR-STONE, is a remarkable variety of this beautiful gem: it is semi-transparent, with a reddish purple tinge.

The view of a silver mine, plate No. 40, accompanied by that of a natural road under the mountain of Filifeld,

Norway, situated in a territory which abounds with mineral productions. This natural curiosity is so well exhibited in this plate, as not to need a particular description.

SALT MINES.

Hence with diffusive salt old ocean steeps
His emerald shallows, and his sapphire deeps.
Oft in wide lakes, around their warmer brim,
In hollow pyramids the crystals swim;
Or, fused by ea.th-born fires, in cubic blocks
Shoot their wide forms, and harden into rocks.

DARWIN.

Culinary salt, or, as it is termed in chemistry, muriat of soda, exists abundantly in a native state, both in a solid form, and dissolved in water It occurs, in solution, not only throughout the wide range of the ocean, but in various springs, rivers, and lakes; and is known, in its solid form, as a peculiar mineral, under the names of *rock-salt*, *fossil-salt*, and *salt-gem*. Its beds are mostly beneath the surface of the ground, but sometimes rise into hills of considerable elevation. At Cordova, in Spain, a hill, between four and five hundred feet in height, is nearly composed of this mineral. But the most celebrated salt mines are those of Wielicza in Gallicia, commonly called the salt mines of Cracow, those of Tyrol, of Poland, of Castille in Spain, and of Cheshire in England. In the province of Lahor, in Hindostan, is a hill of rock-salt of equal magnitude with that near Cordova. The mines of Iletski, in Russia, yield vast quantities of this substance. It is so plentiful in the desert of Caramania, and the air so dry, that it is there used as a material for building. It forms the surface of a large part of the northern desert of Lybia; and is found in great abundance in the mountains of Peru. It has a pure saline taste, without any mixture of bitterness; and chrystalizes in cubes when obtained by slow evaporation from its solution. In Germany the mines of this kind are numerous: one of the largest is that of Hallein, near Saltsburg, in which the salt is hewn out from subterraneous caverns of a considerable range, and exhibits almost every diversity of colour, as yellow, red, blue, and white; in consequence of which it is dissolved in water, to be liberated from its impurities, and after-

wards re-crystalised. The salt mines of Cracow, and those of Cheshire, merit a particular description.

SALT MINES OF CRACOW.

Thus, cavern'd round, in Cracow's mighty mines,
With crystal walls a gorgeous city shines;
Scoop'd in the briny rock long streets extend
Their hoary course, and glittering domes ascend:
Down their bright steeps, emerging into day,
Impetuous fountains burst their headlong way,
O'er milk-white vales in ivory channels spread,
And wondering seek their subterraneous bed.
Form'd in pellucid salt, with chissel nice,
The pale lamp glittering through the sculptur'd ice.
With wild reverted eyes fair Lotta stands,
And spreads to heaven, in vain, her glassy hands;
Cold dews condense upon her pearly breast,
And the big tear rolls lucid down her vest.
Far gleaming o'er the town, transparent fanes
Rear their white towers, and wave their golden vanes;
Long lines of lustres pour their trembling rays,
And the bright vault resounds with mingled blaze.

DARWIN.

THESE celebrated excavations are about five miles distant from the city of Cracow, in a small town named Wielicza, which is entirely undermined, the cavities reaching to a considerable extent beyond its limits. The length of the great mine, from east to west, is six thousand feet; its breadth, from north to south, two thousand; and its greatest depth eight hundred; but the veins of salt are not limited to this extent, the depth and length of them, from east to west, being yet unknown, and their breadth only hitherto determined. There are at present ten shafts, but not a single spring has been discovered throughout the extent of the mine.

In descending to the bottom, the visitor is surprised to find a kind of subterraneous commonwealth, consisting of many families, who have their peculiar laws and polity. Here are likewise public roads and carriages, horses being employed to draw the salt to the mouths of the mine, where it is taken up by engines. These horses, when once arrived at their destination, never more see the light of the sun: and many of the people seemed buried alive in this strange abyss, having been born there, and never stirring out; while others are not denied frequent oppor-

tunities of breathing the fresh air in the fields, and enjoying the surrounding prospects. The subterraneous passages, or galleries are very spacious, and in many of them chapels are hewn out of the rock-salt. In these passages crucifixes are set up, together with the images of saints, before which a light is kept constantly burning. The places where the salt is hewn out, and the empty cavities whence it has been removed, are called chambers, in several of which, where the water has stagnated, the bottoms and sides are covered with very thick incrustations of thousands of salt crystals, lying one on the other, and many of them weighing half a pound and upwards. When candles are placed before them, the numerous rays of light reflected by these crystals emit a surprising lustre.

In several parts of the mine huge columns of salt are left standing, to support the rock; and these are very fancifully ornamented. But the most curious object in the inhabited part, or subterraneous town, is a statue which is considered by the immured inhabitants as the actual transmutation of Lot's wife into a pillar of salt; and in proportion as this statue appears either dry or moist, the state of the weather above ground is inferred. The windings in this mine are so numerous and intricate, that the workmen have frequently lost their way; and several, whose lights have been extinguished, have thus perished. The number of miners to whom it gives employment, is computed at between four and five hundred; but the whole amount of the men employed in it is about seven hundred.

The salt lies near the surface, in large shapeless masses out of which blocks of sixty, eighty, or a hundred feet square, may be hewn; but at a considerable depth it is found in smaller lumps. About six hundred thousand quintals of salt are dug annually out of the mines of Cracow. The worst and cheapest is called green salt, from its greenish colour, occasioned by an heterogenous mixture of a greyish mineral, or clay, and entirely consists of salt crystals of different dimensions. A finer sort is dug out in large blocks; and the third kind is the *sal gemmæ*, or crystal salt, which is found in small pieces interspersed in the rock, and, when detached from it, breaks into cubes of rectangular prisms. This is usually sold unprepared;

The colour of the salt stone is a dark grey mixed with yellow.

SALT MINES AND SALT SPRINGS OF CHESHIRE.

The Cheshire rock-salt, with very few exceptions, has hitherto been ascertained to exist only in the vallies bordering on the river Weaver and its tributary streams; in some places manifesting its presence by springs impregnated with salt, and in others being known by mines actually carried down into the substance of the salt strata. Between the source of the Weaver and Nantwich, many brine springs make their appearance; and occur again at several places, in proceeding down the stream. At Moulton, a mine has been sunk into the body of rock-salt, and a similar mine is wrought near Middlewich. At Northwich, brine springs are very abundant; and there also many mines have been sunk for the purpose of working out the fossil salt. In that vicinity a body of rock salt has been met with in searching for coal.

The brines in this district are formed by the penetration of spring or rain waters to the upper surface of the rock salt, in passing over which they acquire such a degree of strength, that one hundred parts have yielded twenty-seven of pure salt, thus nearly approaching to the perfect saturation of brine. Their strength is therefore much greater than that of the salt springs met with in Hungary, Germany, and France. The brine having been pumped out of the pits, is first conveyed into large reservoirs, and afterwards drawn off as it is needed, into pans made of wrought iron. Here heat is applied in a degree determined by the nature of the salt to be manufactured, and various additions are made to the brine, with a view either to assist the crystallization of the salt, or to promote the separation of the earthy particles, which exist in a very small proportion. The importance of the manufacture of Cheshire salt will be sufficiently obvious from the statement, that, besides the salt made for home consumption, the annual amount of which exceeds 16,000 tons, the average of the quantity sent yearly to Liverpool for exportation, has not been less than 140,000 tons.

The mine of rock salt first worked was discovered by accident at Marbury, near Northwich, about a century and

a half ago; and this bed had been wrought for more than a century, when, in the same neighbourhood, a second and inferior stratum was fallen in with, separated from the former by a bed of indurated clay. This lower stratum was ascertained to possess a very great degree of purity, and freedom from earthy admixture; on which account, and from the local advantages of Northwich for exportation, the fossil salt is worked in the vicinity of that place only. It occurs in two great strata or beds, lying nearly horizontally, and separated, the superincumbent from the subjacent stratum, by several layers of indurated clay, or argillaceous stone. These intervening beds possess in conjunction a very uniform thickness of from thirty to thirty-five feet, and are irregularly penetrated by veins of fossil salt. There is every reason to believe that the beds of rock salt at Northwich, are perfectly distinct from any others in the salt district, and form what are termed by mineralogists *incumbent bodies* or *masses of mineral.*

These enormous masses stretch a mile and a half in a longitudinal direction from north-east to south-west; but their transverse extent, as measured by a line at right angles from the former, does not exceed 4,200 feet, somewhat more than three quarters of a mile. Without this area, the brine which is met with is of a very weak and inferior quality, and at a short distance disappears altogether. The thickness of the upper bed varies from sixty to ninety feet; and a general estimate made from its level, shows that its upper surface, which is ninety feet beneath that of the earth, is at least thirty-six feet beneath the low water mark of the sea at Liverpool—a fact not unimportant in determining the nature of the formation of this mineral. The thickness of the lower bed has not hitherto been ascertained; but the workings are usually begun at the depth of from sixty to seventy-five feet, and are carried down for the space of fifteen or eighteen feet, through what forms the purest portion of the bed. In one of the mines a shaft has been sunk to a level of forty-two feet still lower, without passing through the body of rock-salt. There is thus an ascertained thickness of this bed of about a hundred and twenty feet, and without any direct evidence that it may not extend to a considerably greater depth.

Although two distinct beds only of fossil salt have been

met with at Northwich, it has been ascertained that the same limitations do not exist throughout the whole of the salt district. At Lawton, near the source of the river Wheelock, three distinct beds have been found, separated by strata of indurated clay: one at the depth of 126 feet, four feet in thickness; a second, thirty feet lower, twelve feet in thickness; and a third, forty-five feet farther down, which was sunk into seventy-two feet, without passing through its substance. The intervening clay, the structure of which is very peculiar, is called the SHAGGY METAL, and the fresh water which passes through its pores has the expressive appellation of ROARING MEG. This epithet will not appear too strong, when it is mentioned that in a mine in which the section of strata was taken, and where the shaggy metal was found at the depth of about eighty feet, the quantity of water ascertained to issue from its pores in one minute, was not less than three hundred and sixty gallons; a circumstance which greatly enhances the difficulty of passing a shaft down to the body of rock-salt.

In many of these beds of argillaceous stone, a portion of salt, sufficiently strong to affect the taste, is found to exist; and this saltness increases, as might be expected, in proportion as the body of rock-salt is approached: in the strata or layers immediately above the rock, which in all the mines are perfectly uniform in their appearance and structure, it is particularly remarkable, notwithstanding there are not, in these strata, any veins of rock-salt connected with the great mass below. On the contrary, the line between the clay and rock-salt is drawn with great distinctness in every instance, without presenting any of those inequalities which would arise from a mutual penetration of the strata. Not any marine exuviæ, or organic remains, are found in the strata above the rock-salt; and the almost universal occurrence of gypsum, in connexion with beds of fossil salt, is a fact still more deserving of observation, because it appears, not only in these mines, but also in the salt mines of Hungary, Poland, and Transylvania, on which account Werner, in his geognostic system, assigns to the rock-salt and floetz gypsum a conjunct situation.

The fossil salt extracted from the Northwich mines is of different degrees of purity, and more or less blended

with earthy and metallic substances. The purer portion of the lower bed yields a rock-salt, which, being principally exported to the Baltic, obtains the name of Prussian rock. The extent of the cavity formed by the workings varies in different mines, the average depth being about sixteen feet. In some of the pits, where pillars from eighteen to twenty-four feet square form the supports of the mine, the appearance of the cavity is singularly striking, and the brilliancy of the effect is greatly increased when the mine is illuminated by candles fixed to the sides of the rock. The scene thus formed almost appears to realise the magic palaces of eastern poets. Some of the pits are worked in aisles or streets, but the choice here is wholly arbitrary. Among the methods employed in working out the rock-salt, the operation of blasting is applied to the seperation of large masses from the body of the rock; and these are afterwards broken down by the mechanical implements in common use. The present number of mines is eleven or twelve, from which there are raised, on an annual average, fifty or sixty thousand tons of rock-salt. The greater part of this quantity is exported to Ireland and the Baltic, the remainder being employed in the Cheshire district, in the manufacture of white salt by solution and subsequent evaporation.

The general situation occupied by the rock-salt in Cheshire is very similar to that of the Transylvanian and Polish mines, the beds of this mineral being disposed in small plains, bounded by hills of inconsiderable height, forming a kind of basin or hollow, from which there is usually only a narrow egress for the waters. The situation of the Austrian salt mines near Saltzburg is, however, very different. The mineral there appears to be disposed in beds of great thickness, which occur near the summits of limestone hills, at a great elevation above the adjoining country. This is a singular fact; and if the hypothesis be allowed that rock-salt is formed from the waters of the sea, it is necessary to suppose the occurrence on this spot of the most vast and surprising changes!

The theory of the formation of rock-salt presents some difficulties, at the same time that little doubt can exist of the general fact, that the beds of this mineral have been formed of deposition from the waters of the sea. Such an

opinion acquires much probability from the situation in which these beds usually occur; occupying the vallies and lower parts of the plains which are so surrounded by hills of secondary formation, as to leave only a narrow egress for the waters collected on their surface. The structure of the plain which constitutes the salt district of Cheshire, regarded in its general character, leads strongly to the conclusion that the waters of the sea must, at some former period, have occupied the lower parts at least of the basin thus formed, which at that time had a level lower by two hundred and fifty or three hundred feet than the one now appearing. To account for the great depositions of salt in the lower part of this basin, it is necessary to suppose that some barrier must have been afterwards interposed to prevent the free communication of the waters of the sea with those thus collected; and the general course of the streams, the position of the beds of rock-salt, and the contractions in the valley of the Weaver, which appear below Northwich at Anderton and Frodsham, point out with some distinctness the place where these obstructions may probably have occurred.

The principal objection to this theory undoubtedly is, the non-existence of marine exuviæ, either in the rock-salt, or in the adjacent strata of clay; a fact very difficult to connect with the idea of a deposition from the waters of the sea. Other objections, though, perhaps of less moment, arise from the appearance of the earthy salts in smaller proportion in the rock salt than in sea water; from the apparently partial depositions of the beds; and from the difficulty of explaining the formation of certain figured appearances which occur in the substance of the rock. These circumstances, however, by no means authorize the rejection of the general idea which has been given of the origin of this mineral, strengthened as it is by the situation and appearances observed in the foreign salt mines, where the proofs of marine deposition are still stronger than those presented in the Cheshire district.

PHENOMENA OF THE OCEAN.

They that go down to the sea in ships, that do business in great waters; these see the works of the Lord, and his wonders in the deep.—Psalms.

With wonder mark the moving wilderness of waves,
From pole to pole through boundless space diffused,
Magnificently dreadful! where, at large,
Leviathan, with each inferior name
Of sea-born kinds, ten thousand thousand tribes,
Find endless range for pasture and for sport.
Adoring own
The Hand Almighty, who in channelled bed
Immeasurable sunk, and poured abroad,
Fenced with eternal mounds, the fluid sphere;
With every wind to waft large commerce on.
Join pole to pole, consociate severed worlds,
And link in bonds of intercourse and love
Earth's universal family.

Mallet.

That huge mass of waters impregnated with salt, which encompasses all parts of the globe, and by the means of which, in the present improved state of navigation, an easy intercourse subsists between the most distant nations, is denominated the ocean, and has three grand divisions assigned to it. First: That vast expanse of water which lies to the westward of the northern and southern continents of America, and by which those continents are divided from Asia. On account of the uniform and temperate gales which sweep its surface within the tropics, it is named "the Pacific Ocean;" and has again been distinguished into the Northern and Southern Pacific, the equator being considered as the boundary of each, and "the Southern Ocean," or South Sea, being, consequently, that part of the general assemblage of waters which roll in the direction from about the fortieth degree of latitude towards the south pole. Its general width is estimated at about ten thousand miles. Secondly: The "Atlantic Ocean," which divides Europe and Africa from the two American continents, and has a general width of about three thousand miles; while the waters which occupy the polar regions are named "The Northern sea." And, lastly: "The Indian Ocean," which extends from the

eastern shores of Africa along the southern coasts of Asia, and has the same general width with the preceding one.

Among the chief of those less expansive sheets of water, properly called seas, may be mentioned the Baltic, the Mediterranean Sea, and the Black and Red Seas. The Caspian Sea, being entirely encompassed by land, might, with more propriety, have been styled a lake; but as its water possesses the quality of saltness, it is ranked among the seas. It is, notwithstanding, certain that Lake Superior, in North America, has a still greater circumference, extending around its shores at least fourteen hundred miles, while the extent of the Caspian does not exceed twelve hundred.

Of the origin of this division into different seas, and seas of different depths, little is known; but it is highly probable that many of the larger excavations and partitions now met with, have existed, without much change as to their extent from the creation. Others have undoubtedly, been the result of that conflict which is perpetually taking place between the elements of land and water, and which has, for the greater part, given rise to islands, isthmuses, and peninsulas; while subterraneous volcanoes, and those truly surprising and indefatigable exertions of coral, madrepores, tubifores, and other restless and multitudinous zoophites, have laid, and are daily laying the foundation of new islands and continents in the middle of the widest and deepest seas.

The *quantity* of water in the ocean not only remains constantly the same; but, notwithstanding its most violent and incessant motion, continues *stable* within certain limits. This, however, is what cannot be inferred from observation; for, although in the almost infinite variety of disturbances to which the ocean is liable, from the action of irregular causes, it may appear to return to its former state of equilibrium, still it may be apprehended that some extraordinary cause may communicate to it a shock, which, though inconsiderable as its origin, may augment continually, and elevate it above the highest mountains. It is, therefore, interesting to investigate the conditions which are necessary for the absolute stability of the ocean. This has been effected by the celebrated Laplace, who has demonstrated that the equilibrium of the ocean must be

stable, if its density be *less* than the mean density of the earth, which is known to be the case. He has likewise determined, by means of his refined analysis; that this stability would cease to exist, if the mean density of the sea *were to exceed* that of the earth; so that the stability of the equilibrium of the ocean, and the excess of the density of the terrestrial globe above that of the waters which cover it, are reciprocally connected with each other, and indicate infinite wisdom and contrivance in such an adjustment.

SALTNESS OF THE SEA.

Of the various phenomena of the sea, that of its saltness is one of the most obvious. No questions concerning the natural history of our globe have been discussed with more attention, or decided with less satisfaction, than that concerning its primary cause, which had perplexed the philosophers before the time of Aristotle, and surpassed even the great genius of that profound enquirer into natural causes. Father Kircher, after having consulted not less than thirty-three authors on this subject, could not help remarking, that the fluctuations of the ocean itself were scarcely more various, than the opinions concerning the origin of its saline impregnation.

This question does not seem capable of admitting an illustration from experiment; at least, not any experiments have been hitherto made for that purpose: it is, therefore, not surprising that it remains nearly as problematical in the present age, as it has been in any of the preceding. Had observations been made three or four centuries ago, to ascertain the then saltness of the sea, at any particular time and place, we might now, by making similar observations at the same place, in the same season, have been able to know, whether the saltness, at that particular place, was an increasing, or a decreasing, or an invariable quantity. This kind and degree of knowledge would have served as a clue to direct us to a full investigation of this matter in general. It is to be regretted, however, that observations of this nature have not, until very lately, been made with any degree of precision.

One of the principal opinions maintained on this subject by modern philosophers, and more particularly supported by Doctor Halley, is, that since river water, in almost

every part of the globe, is impregnated, in a greater or less degree, by sea-salt, the sea must have gradually acquired its present quantity of salt from the long continued influx of rivers. The water which is carried into the sea by these rivers, is again separated from it by evaporation, and being dispersed over the atmosphere by winds, soon descends in rain or vapour upon the surface of the earth, whence it hastens to pour into the bosom of the ocean the fresh tribute of salt it has collected in its inland progress. Thus the salt conveyed into the sea not being a volatile substance, nor performing an incessant circulation, must be a perpetually increasing quantity; and sufficient time, it is contended, has elapsed, since the creation, for the sea to acquire from this source its present quantity of salt.

This opinion has been successfully combated; and it is denied that fresh water rivers can, in the course of many thousand years, have produced saltness in the sea. If this were the case, every sea, or great body of water, which receives rivers, must have been salt, and have possessed a degree of saltness in proportion to the quantity of water which these rivers discharge. But so far is this from being true, that the Palus Mæotis, and the great American lakes, do not contain salt water but fresh. It may indeed be objected, that the quantity of salt which rivers carry along with them, and deposit in the sea, must depend on the nature of the soil through which they flow, which may in some places not contain any salt; and that this is the reason why the great lakes in America, and the Palus Mæotis are fresh. But to this opinion, which is merely hypothetical, there are insurmountable objections. It is a curious fact, that the saltness of the sea is greatest under the line, and diminishes gradually towards the poles; but it cannot therefore be assumed that the earth contains more salt in the tropical regions than in the temperate zones, and more in these again than in the frigid zones. On the other hand, if it be allowed that the sea receives its saltness from the rivers, it must be equally salt, or nearly so, in every part of the earth; since, according to a simple and well known principle in chemistry, *when any substance is dissolved in water with the assistance of agitation, at whatever part of the water it is introduced, it will be equally diffused through the whole liquid.* Now, though

it were true that a greater quantity of salt should have been introduced into the sea under the line, than towards the poles, from the constant agitation occasioned by the wind and tide, the salt must have soon pervaded the whole mass of water. Neither is this greater proportion of saltness owing to a superior degree of heat, since it is an established principle in chemistry, that cold water and hot water dissolve nearly the same proportion of salt.

The saltness of the sea has also been ascribed to the solution of subterraneous mines of salt, that are supposed to abound in the bottom of the sea, and along its shores. But this hypothesis cannot be supported. If the sea were constantly dissolving salt, it would soon become saturated; for it cannot be said that it is deprived of any portion of its salt by evaporation, since rain water is fresh. If the sea were to become saturated, neither fishes nor vegetables could live in it. It may hence be inferred that the saltness of the sea cannot be accounted for by secondary causes, and that it has been salt since the beginning of time. It is, indeed impossible to suppose that the waters of the sea were at any time fresh since the formation of fishes and sea-plants; neither will they live in water which is fresh. It may hence be concluded that the saltness of the sea has, with some few exceptions, perhaps arising from mines of rock-salt dispersed near its shores, been nearly the same in all ages. This hypothesis, which is the simplest, and is involved in the fewest difficulties, best explains the various pheuomena dependent on the saltness of the sea.

Although this saline property may be one of the causes by which the waters of the sea are preserved from putridity, still it cannot be considered as the principal cause. The ocean has, like rivers, its currents, by which its contents are circulated round the globe; and these may be said to be the great agents which keep it sweet and wholesome. A very enlightened navigator, Sir John Hawkins, speaks of a calm in which the sea, having continued for some time without motion, assumed a very formidable aspect. "Were it, not," he observes, "for the moving of the sea, by the force of winds, tides, and currents, it would corrupt all the world. The experiment of this I I saw in the year 1590, lying with a fleet about the Islands of Azores, almost six months, the greater part of which

time we were becalmed. Upon which all the sea became so replenished with various sorts of gellies, and forms of serpents, adders, and snakes, as seemed wonderful; some green, some black, some yellow, some white, some of divers colours, and many of them had life; and some there were a yard and a half, and two yards long; which, had I not seen, I could hardly have believed. And hereof are witnesses all the companies of the ships which were then present; so that hardly a man could draw a bucket of water clear of some corruption. In which voyage, toward the end thereof, many of every ship fell sick, and began to die apace. But the speedy passage into our country, was a remedy to the crazed, and a preservative to those who were not touched."

CONGELATION OF SEA WATER.

Although the assertion that salt water never freezes has been contradicted by repeated experience, it is still certain that it requires a much greater degree of cold to produce its congelations than fresh water. It is, therefore, one of the greatest blessings which we derive from this element, that when we find all the stores of nature locked up to us on the land, the sea is, with a few exceptions, ever open to our necessities. It is well known that at particular seasons, the mouth of the river St. Lawrence, the entrance into the Baltic Sea, &c. are so much frozen over as to be impassible by ships: while the vast mountains and fields of ice in the polar regions have for ages past, been insurmountable obstructions to the daring researches of modern navigators. These exceptions, however, will appear of comparatively trifling importance to navigation, when the number of ports which are, in almost every region, open at all seasons of the year, are considered; and this facility of intercourse would certainly not have been afforded, if sea water had admitted of as easy a congelation as that of water not impregnated with salt.

On the origin of ice in the frozen seas different opinions have been entertained. The authority of Captain Cook and Lord Mulgrave has been cited by Bishop Watson, to show that good fresh water may be procured from ice found in those seas; but he observes that, notwithstanding the testimonies of these very able navigators, it may still be

doubted whether the ice from which the water was obtained, had been formed in the sea, and, consequently, whether sea water itself would, when frozen yield fresh water. He thinks it probable that the ice had either been formed at the mouths of large fresh water rivers, and had thence, by tides or torrents, been drifted into the sea, or that it had been broken by its own weight, from the immense cliffs of ice and frozen snow, which, in countries where there are few rivers, are found in high latitudes to project a great way into the sea. An early navigator, Fotherbye, in the relation of his voyage toward the South Pole, in 1614, considers snow to be the original cause of the ice found at sea, he himself having observed it to lie an inch thick on the surface; and Captain Cook from his own observations in the South Sea, was disposed to think, that the vast floats of ice he met with in the spring, were formed from the congelation of snow. It is certain that the snow which falls upon the surface of the sea, being in a solid state, and, bulk for bulk, lighter than sea water, will not readily combine with it, but may, by a due degree of cold in the atmosphere, be speedily converted into a layer of ice. The upper layer of this first surface of ice being elevated above the surface of the sea, will receive all the fresh water which falls from the atmosphere in the form of snow, sleet, rain, or dew, by the successive congelation of which the largest fields of ice may at length be formed.

It is a matter of little consequence to a navigator, whence the ice which supplies him with fresh water is produced. Leaving, therefore, these hypotheses relative to the formation of ice in Frozen Seas, it should be observed that the question, whether congealed sea water will, when thawed, yield fresh water, has been satisfactorily decided by experiments made with every suitable attention. A quantity of sea water having been taken up off the North Foreland, was exposed to a freezing atmosphere, and afforded an ice perfectly free from any taste of salt; and it has likewise been found, that not only sea water, but water containing double the proportion of salt commonly found in our sea water, and more than is contained in the sea water of any climate, may be frozen by the cold prevailing in our atmosphere.

ICE ISLANDS.

[*See Plate, No.* 37.]

This name is bestowed by seamen on the huge solid masses of ice which float on the sea near or within the Polar circles. Many of these fluctuating islands are met with on the coasts of Spitzbergen, to the great danger of the vessels employed in the Greenland fishery. In the midst of these tremendous masses, navigators have been arrested and frozen to death. In this manner the brave Sir Hugh Willoughby perished with all his crew in 1553; and in the year 1773, Lord Mulgrave, after every effort which the most accomplished seaman could make, to reach the termination of his voyage, was caught in the ice, and nearly experienced the same unhappy fate. The scene he describes, divested of the horrors attendant on the eventful expectation of change, was most beautiful and picturesque. Two large ships becalmed in a vast bason, surrounded on all sides by ice islands of various forms; the weather clear; the sun gilding the circumambient ice, which was smooth, low, even, and covered with snow, except where pools of water, on a portion of the surface, shot forth new icy crystals; and the smooth surface of the comparatively small space of sea in which they were hemmed. Such is the picture drawn by our navigator, amid the perils by which he was surrounded.

After fruitless attempts to force their way through the fields of ice, the limits of these became at length so contracted, the ships were immoveably fixed. The smooth extent of surface was soon lost: the pressure of the pieces of ice, by the violence of the swell, caused them to pack; and fragment rose upon fragment, until they were in many places higher than the main-yard. The movements of the ships were tremendous and involuntary, in conjunction with the surrounding ice, actuated by the currents. The water having shoaled to fourteen fathoms, great apprehensions were entertained, as the grounding of the ice, or of the ships, would have been equally fatal: the force of the ice might have crushed them to atoms, or have lifted them out of the water, and have overset them; or, again, have left them suspended on the summits of the pieces of ice at a tremendous height, exposed to the fury of the winds, or to

the risk of being dashed to pieces by the failure of their frozen dock. An attempt was made to cut a passage through the ice; but after a perseverance truly worthy of Britons, it proved ineffectual. The commander, who was at all times master of himself, directed the boats to be made ready to be hauled over the ice, till they should reach navigable water, proposing in them to make the voyage to England; but after they had thus been drawn over the ice, for three progressive days, a wind having sprung up, the ice separated sufficiently to yield to the pressure of the ships in full sail. After having laboured against the resisting fields of ice, they at length reached the harbour of Smeeringberg, at the west end of Spitzbergen.

The vast islands of floating ice which abound in the high southern latitudes, are a proof that they are visited by a much severer degree of cold than equal latitudes towards the north pole. Captain Cook, in his second voyage, fell in with one of these islands in latitude 50° 40′ south. It was about fifty feet high, and half a mile in circuit, being flat on the top, while its sides, against which the sea broke exceedingly high, rose in a perpendicular direction. In the afternoon of the same day, the 10th of December, 1773, he fell in with another large cubical mass of ice, about two thousand feet in length, four hundred feet in breadth, and in height two hundred feet. Mr. Foster, the naturalist of the voyage, remarks that, according to the experiments of Boyle and Marian, the volume of ice is to that of sea water as 10 to 9: consequently by the known rules of hydrostatics, the volume of ice which rises above the surface of the water, is to that which sinks below it as 1 to 9. Supposing, therefore, this mass of ice to have been of a regular figure, its depth under water must have been 1800 feet, and its whole height 2000 feet: estimating its length, as above, at 2000 feet, and its breadth at 400 feet, the entire mass must have contained 1600 millions of cubic feet of ice.

Two days after, several other ice-islands were seen, some of them nearly two miles in circuit, and 600 feet high; and yet such was the force of the waves, that the sea broke quite over them. They exhibited for a few moments a view very pleasing to the eye; but a sense of danger soon filled the mind with horror: for had the ship struck against the weather side of one of these islands, when the sea ran

high, she must in an instant have been dashed to pieces. The route to the southward was afterwards impeded by an immense field of low ice, the termination of which could not be seen, either to the east, west, or south. In different parts of this field were islands, or hills of ice, like those which had before been found floating in the sea.

At length these ice-islands became as familiar to those on board as the clouds and the sea. Whenever a strong reflection of white was seen on the skirts of the sky, near the horizon, then ice was sure to be encountered; notwithstanding which, that substance itself was not entirely white, but often tinged, especially near the surface of the sea, with a most beautiful sapphirine, or rather berrylline blue, evidently reflected from the water. This blue colour sometimes appeared twenty or thirty feet above the surface, and was propably produced by particles of sea water which had been dashed against the mass in tempestuous weather, and had penetrated into its interstices. In the evening, the sun setting just behind one of these masses, tinged its edges with gold, and reflected on the entire mass a beautiful suffusion of purple. In the larger masses were frequently observed shades or casts of white, lying above each other in strata, sometimes of six inches, and at other times of a foot in height. This appearance seemed to confirm the opinion entertained relative to the increase and accumulation of such huge masses of ice, by heavy falls of snow at different intervals: for snow being of various kinds, small-grained, large-grained, in light feathery locks, &c.; the various degrees of its compactness may account for the different colours of the strata.

In his third attempt to proceed southward, in January, 1774, Captain Cook was led, by the mildest sun-shine which was, perhaps, ever experienced in the frigid zone, to entertain hopes of penetrating as far towards the south pole as other navigators have done towards the north pole; but on the 26th of that month, at four in the morning, his officers discovered a solid ice-field of immense extent, before them, bearing from east to west. A bed of fragments floated around this field, which was raised several feet above the surface of the water. While in this situation, the southern part of the horizon was illuminated by the rays of light reflected from the ice, to a considerable height.

Ninety-seven ice-islands were distinctly seen within the field, besides those on the outside; many of them very large, and looking like a ridge of mountains, rising one above the other until they were lost in the clouds. The most elevated and most ragged of these ice-islands were surmounted by peaks, and were from two to three hundred feet in height, with perpendicular cliffs or sides astonishing to behold. The largest of them terminated in a peak not unlike the cupola of St. Paul's.

The outer, or northern edge, of this immense field of ice, was composed of loose or broken ice closely packed together, so that it was not possible to find any entrance. Such mountains of ice, Captain Cook was persuaded, were never seen in the Greenland seas, so that not any comparison could be drawn; and it was the opinion of most of the persons on board, that this ice extended quite to the pole, to which they were then within less than nineteen degrees; or, perhaps, joined to some land to which it had been fixed from the earliest time. Our navigator was of opinion that it is to the south of this parallel that all the ice is formed, which is found scattered up and down to the northward, and afterward broken off by gales of wind, or other causes, and brought forward by the currents which are always found to set in that direction in high latitudes. "Should there," he observes, "be land to the south behind this ice, it can afford no better retreat for birds, or any other animals, than the ice itself, with which it must be wholly covered. I, who was ambitious, not only to go farther than any one had been before, but as far as it was possible for man to go, was not sorry at meeting with this interruption; as it in some measure relieved us, or at least shortened the dangers and hardships inseparable from the navigation of the southern polar regions."

The approximation of several fields of ice of different magnitudes produces a very singular phenomenon. The smaller of these masses are forced out of the water, and thrown on the larger ones, until at length an aggregate is formed of a tremendous height. These accumulated bodies of ice float in the sea like so many rugged mountains, and are continually increased in height by the freezing of the spray of the sea, and the melting of the snow which falls on them. While their growth is thus augmented,

the smaller fields, of a less elevation, are the meadows of the seals, on which these animals at times frolic by hundreds.

The collisions of great fields of ice, in high latitudes, is often attended by a noise, which, for a time, takes away the sense of hearing any thing beside; and that of the smaller fields with a grinding of unspeakable horror. The water which dashes against the mountainous ice, freezes into an infinite variety of forms, and presents to the admiring view of the voyager ideal towns, streets, churches, steeples, and almost every form which imagination can picture to itself.

ICEBERGS.

ANALOGOUS to the ice-fields described above, are those large bodies of ice, named ICEBERGS, which fill the vallies between the high mountains in northern latitudes. Among the most remarkable are those of the east coast of Spitzbergen. They are seven in number, and lie at considerable distances from each other, extending through tracts unknown, in a region totally inaccessible in the internal parts. The most distant of them exhibits over the sea a front three hundred feet in height, emulating the colour of the emerald: cataracts of melted snow fall down in various parts; and black spiral mountains, streaked with white, bound the sides, rising crag above crag, as far as the eye can reach in the back-ground. At times immense fragments break off, and precipitate themselves into the water with a most alarming dashing. A portion of this vivid green substance was seen by Lord Mulgrave, in the voyage above referred to, to fall into the sea; and, notwithstanding it grounded in twenty-four fathoms water, it spired above the surface fifty feet. Similar icebergs are frequent in all the arctic regions; and to their lapse is owing the solid mountainous ice which infests those seas.

The frost sports wonderfully with these icebergs, and gives them majestic, as well as other most singular forms. Masses have been seen to assume the shape of a gothic church, with arches windows and doors, and all the rich drapery of that style of architecture, composed of what the writer of an Arabian tale would scarcely have ventured to introduce among the marvellous suggestions of his fancy—*crystals of the richest sapphirine blue*. Tables with one or

more feet; and often immense flat-roofed temples, like those of Luxor on the bank of the Nile, supported by round transparent columns of cerulean hue, float by the astonished spectator. These icebergs are the creation of ages, and acquire annually additional height by falls of snow and rain, which latter often freezes instantly, and more than repairs the loss occasioned by the influence of the sun's heat.

LUMINOUS POINTS IN THE SEA.

Among the phenomena which have long exercised the sagacity of philosophers, that of the luminous appearance of the surface of the sea, during the obscurity of the night, is highly curious. A variety of experiments were made by a French naturalist at Cayenne, at different seasons, to ascertain its true cause; and to him it appeared that these luminous points were produced by motion and friction alone, as he could not, with the help of the best glasses, perceive any insects floating in the water. But it would seem, from the experiments and observations of many learned men, that this phenomenon is produced by various causes, both jointly and separately. It has been proved by one set of experiments, that the putrefaction of animal substances produces light and scintillation in the sea. A little white fish placed in sea-water rendered it luminous in the space of twenty-eight hours. On another hand, it is certain that there is in the sea a prodigious quantity of shining insects or animalcules, which contribute to this phenomenon. A French astronomer, M. Dangelet, who returned from Terra Australis in 1774, brought with him several kinds of worms which shine in water, when it is set in motion; and M. Rigaud affirms, that the luminous surface of the sea, from Brest to the Antilles, contains an immense quantity of little, round, shining polypi, of about a quarter of a line in diameter. Other learned men, who acknowledge the existence of these luminous animals, cannot, however, be persuaded to consider them as the cause of all that light and scintillation which appear on the surface of the ocean. They imagine that some substance of a phosphoric nature, arising from putrefaction, must be admitted as one of the causes of this phenomenon. By other naturalists it has been ascribed to the oily and greasy substances with which the sea is impregnated; in proof

of which a kind of fish, resembling the tunny, is cited, as being provided with an oil which shines with considerable lustre.

The Abbe Nollet was convinced, by a series of experiments, that this phenomena is caused by small animals, either by their luminous aspect, or by some liquor or effluvium which they emit. He did not, however, exclude other causes; and among these, the spawn or fry of fishes is deserving of attention. M. Dangelet, in sailing into the bay of Antongil, in the island of Madagascar, observed a prodigious quantity of fry, which covered the surface of the sea for the extent of more than a mile, and which he, at first, on account of its colour, mistook for a bank of sand. This immense accumulation of spawn or fry exhaled a disagreeable odour; and it should be remarked that the sea, had, for some days before, appeared with uncommon splendour. The same accurate observer, perceiving the sea remarkably luminous in the road of the Cape of Good Hope, during a perfect calm, remarked that the oars of the canoes produced a whitish and pearly kind of lustre: when he took in his hand the water, which contained phosphorus, he discerned in it, for some minutes, globules of light as large as the heads of pins. On pressing these globules, they appeared to his touch like a soft and thin pulp; and some days after the sea was covered with entire banks of small fishes, in innumerable multitudes.

From all these facts it may be deduced, that various causes contribute to the light and scintillation of the sea; and that the light which the Cayenne naturalist attributed to agitation and friction, differs from that which is extended far and near, seeming to cover the whole surface of the ocean, and producing a very beautiful and striking appearance, particularly in the torrid zone, and in the summer season.

TIDES AND CURRENTS.

Alternate tides in sacred order run.

BLACKMORE.

AMONG the most wonderful phenomena of nature may be reckoned the tides of the sea. They were but little understood by the ancients, although Pliny, Ptolemy, and Macrobius, were of opinion that they were influenced by the sun and moon. The former expressly says, that the

cause of the ebb and flow is in the sun, which attracts the waters of the ocean; and he adds, that the waters rise in proportion to the proximity of the moon to the earth.

The phenomena of the tides have been ascribed to the principle of *innate* gravitation; but Sir Richard Phillips, in his theory of the System of the Universe, refers them to that general law of motion which he considers as the primary and proximate cause of all phenomena, operating, in a descending series, from the rotation of the sun round the fulcrum of the solar system, to the fall of an apple to the earth. This motion being transferred through all nature from its source, serves as the efficient cause of every species of vitality, of every organic arrangement, and of all those accidents of body heretofore ascribed to attraction.

The waters of the ocean are observed to flow and rise twice a day, in which motion, or flux, which in the same direction lasts nearly six hours, the sea gradually swells, and, entering the mouths of rivers, drives back the river waters towards their head. After a continued flux of six hours, it seems to repose for a quarter of an hour, and then begins to ebb, or retire back, for six hours more; in which time, by the subsidence of the waters, the rivers resume their usual course. After a quarter of an hour, the sea again flows and rises as before.

According to the theory of Newton, these phenomena were supposed to be produced by an imaginary power called ATTRACTION. The moon was supposed to attract the waters by the *hocus-pocus* of an occult power inherent in all matter; just as the earth was supposed to attract the moon, the moon the earth, and the planets one another.—This might be very good philosophy as long as *names* were admitted as efficient *causes;* but the more inquisitive spirit of modern philosophy asks how any attraction, or operative force of the nature of attraction, can exist between bodies necessarily separated, according to the same theory, by a *vacuum* in space, and prevented from falling together by the further necessary hypothesis of *a projectile force.* Besides, in the phenomena of the tides, it was unfortunate for this gravitating theory, that the tides rise on the opposite sides of the earth at the same time.

The entire theory of all occult attraction and repulsion is, however, visionary and fabulous, and must yield, before

the light of reason, to the new theory, which ascribes all phenomena of motion to superior motions, or to the transfer of the motions of greater bodies to smaller ones. Thus, all motions which we witness on the earth, as the tides of the waters and atmosphere, the fall of bodies, the principle of weight or centripetal force, the motions of animals, &c. &c. are ascribed, by Sir Richard Phillips, to the combined motions of the earth around its axis in every twenty-four hours, and around the sun in every year.

It is easy to conceive, that even if there were no Moon, the moving waters of the two great oceans, the Atlantic and Pacific, would necessarily oscillate, or vibrate, between the continents, which bound them from north to south, by the combined force of the two-fold motions of the earth. They would be intercepted in their rotation by those continents on the eastern side, which it is well known are worn away by their action; and a re-action would take place on the western sides of the same continents. But as the motions of the moon, in its lunar orbit, coincide with those of the tides in their terrestial orbit, there is, evidently, a connexion in the cause of both motions, or rather, the causes of both appear to be identically the same; and the effects are, therefore, simultaneous.

This common cause, Sir Richard Phillips asserts, is to be found in the MOTIONS of the earth, which operate alike on the waters of the earth, and on the moon according to their respective quantities of matter, and to the square of their distances from the centre.

The connection between the earth and its waters is palpable, but that between the earth and the moon is, he asserts, maintained by means of the gaseous, or fluid medium, which fills all space, and transfers the motions of the sun, from the sun to the planets, and their secondaries, and from the planets to their several secondaries. The gaseous medium filling universal space, is he says, in this respect, and in universal nature, as efficient in transferring motion from masses to masses in proportion to their quantity of matter and to their distance, as the contiguous fixed matter of a rod, or lever of wood or metal.

The causes and phenomena of the tides, according to this new system of Phillips, may be described in the following paragraphs:

1. The tides are simple and palpable phenomena of motion, and all motion is caused by other motion.

2. If the earth were a true homogeneous sphere, covered equally with water, and moved or turned by forces acting equally on the ends of its equatorial axis, then all its parts would move simultaneously with equal momenta, and there could be no Tides. But if any inequalities in the density of its masses, or any variation in the direction of the forces caused the centre of gyration to become different from the mathematical centre, then the moveable waters, in their capability of accommodating themselves to the centre of gyration, would constantly change their position in relation to the fixed masses.

3. The earth and moon move round a common centre or *fulcrum*, the arms or distances being in the inverse duplicate ratio of their quantities of matter; and the mundane fluids, in respecting this centre of motion, rise towards the *fulcrum*, which is always in the line joining the centres of the earth and moon; and hence the phenomena of the Tides, governed in successive rotations by the times in which the common fulcrum, passes the meridian.

4. The tides therefore are caused by the revolution of the earth round the fulcrum, or centre of the momentum of the earth and moon, and as the moveable waters, in restoring the equilibrium, accumulate opposite that fulcrum, they have the *appearance* of being attracted, as it is called, by the moon.

5. The double tide in every twenty-four hours is caused by the departure of the *fulcrum* from the sea over the continents which separate the two great oceans from each other, when as no force retains the elevated waters, they relapse or swing back, and produce a second tide.

6. The variable heights of the tides, as apparently connected with the age of the moon, are caused by the variable distance of the body of the earth from the line of its orbicular force, during its revolution round the lunar and mundane centre of motion.

On account of the shallowness of some seas, and the narrowness of the straits in others, there arises a great diversity in the phenomena, only to be accounted for by an exact knowledge of the place. For instance, in the English channel, and the German ocean, the tide is

found to flow strongest in those places that are narrowest, the same quantity of water being, in this case, driven through a smaller passage. It is often seen, therefore, rushing through a strait with great force, and considerably raised, by its rapidity, above that part of the ocean through which it runs.

The shallowness and narrowness of many parts of the sea, give rise also to a peculiarity in the tides of some parts of the world: for in many places, in our own seas in particular the greatest swell of the tide is not while the moon is in its meridian height, and directly over the place, but sometime after it has declined thence. The sea, in this case, being obstructed, pursues the moon with what dispatch it can, but does not arrive with all its waters until after the moon has ceased to operate. Lastly, from this shallowness of the sea, and from its being obstructed by shoals and straits, it happens that the Mediterranean, the Baltic, and the Black Sea, have not any sensible tides, to raise or depress them in a considerable degree.

Among the phenomena of the tides, one of the most singular is the BORE, peculiar to several rivers: it is ascribed to the waters, which were before expansive, being suddenly pent up, and confined within a narrow space. This bore or impetuous rush of waters, accompanies the first flowing of the tide in the Perret, in Somersetshire, and in the Seine, in France. It is also one of the peculiarities of the Severn, the most rapid river in England.

One of the greatest known tides is that of the Bristol Channel, which sometimes flows upwards of forty feet. At the mouth of the river Indus the water rises thirty feet. The tides are also remarkably high on the coasts of Malay, in the straits of Sunda, in the Red Sea, at the mouth of the river St. Laurence, along the coasts of China and Japan, at Panama, and in the gulf of Bengal. The most remarkable tides, however are those at Batsha, in the kingdom of Tonquin, in 20° 50′ north latitude. In that port the sea ebbs and flows once only in twenty-four hours, while in all other places there are two tides within that space. What is still more extraordinary, twice in each month, when the moon is near the equinoctial, there is not any tide, the water being for some time quite stagnant. These, with other anomalies of the tides there, Sir Isaac

Newton, with peculiar sagacity, ascertained to arise from the concurrence of two tides, one from the South Sea, and the other from the Indian Ocean. Of each of these two tides there come successively two every day; two at one time greater, and two at another which are less. The time between the arrival of the two greater was considered by him as high tide; that between the two less, as ebb. In short, with these simple facts in his possession, that great mathematician solved every appearance, and so established his theory as to silence every opposer.

Besides the common and periodical tides, a variety of LOCAL CURRENTS are met with in different seas, on different parts of the ocean, and for the greater part at an inconsiderable distance from land. They have been usually ascribed to particular winds; but their origin is not easy to trace, as they have been occasionally found beneath the surface of the water running in a contrary direction to the stratum above, and cannot, therefore, have been owing to winds or monsoons. These particular currents have been ascribed to the immense masses of polar ice, which produce a greater degree of cold in the under than in the upper stratum of waters; and it has been suspected that there is an under current of cold water flowing perpetually from the poles towards the equator, even where the water above flows towards the poles. The great inferiority of temperature which is frequently found in deep and superficial soundings of the same space of water is thus accounted for.

The most extraordinary current is that of the gulf of Florida, usually called the GULFH-STREAM, which sets along the coast of North America to the northward and eastward, and flows with an uninterrupted rapidity. It is ascribed to the Trade winds, which, blowing from the eastern quarter into the great Mexican gulf, cause there an accumulation above the common level of the sea. The water, therefore, constantly runs out by the channel where it finds least resistance, that is, through the gulf of Florida, with such force as to continue a distinct stream to a very great distance. A proof of its having thus originated is, that the water in the gulf-stream has been found to have retained a great portion of the heat it had acquired in the torrid zone.

A very singular upper current often prevails to the westward of Scilly, and is highly dangerous to ships which ap-

proach the British Channel. Currents of this description, are, however, more frequently met with about the straits of Gibraltar, and near the West India islands, the coasts of which are so subject to counter-tides, or extraordinary currents, that is is often dangerous for boats to land. They proceed to the westward, along the coasts of Jucatan and Mexico, and, running round into the gulf, return into the great ocean, by the straits of Bahama, along the coasts of Florida, in order to pursue, in the north, the course ordained them by the great author of nature. In this course the waters run with an extraordinary rapidity, passing between the great and small American islands in the great deeps, by an almost even and imperceptible motion. Against the shores and coasts of these islands, which form an archipelago, they are, however, very sensible and dangerous, interrupting the navigation, and rendering it scarcely possible to stem them in proceeding to the eastward.

Besides these regular currents, there are others, called COUNTER-TIDES, which are observable on the sea coasts and shores. In places where these flow, the sea rises in an extraordinary manner, becoming very furious without any apparent cause, and without being moved by any wind. The waves rise and open very high, breaking on the shore with such violence, that it is impossible for vessels to land. These counter-tides are chiefly ascribed to the pressure of the heavy black clouds which are occasionally seen to hang over an island, or over the sea.

PRINCIPAL RIVERS.

Tell by what paths, what subterraneous ways,
Back to the fountain's head the sea conveys
The refluent rivers, and the land repays?
Tell what superior, what controlling cause,
Makes waters, in contempt of nature's laws,
Climb up, and gain the aspiring mountain height,
Swift and forgetful of their native weight?
What happy works, what engines underground,
What instruments of curious art are found,
Which must with everlasting labour play,
Back to their springs the rivers to convey,
And keep their correspondence with the sea? BLACKMORE.

Not to mention the great variety of known benefits a river bestows on the country through which it flows, its

winding course becomes a delightful ornament, and renders the most beautiful landscape still more exquisitely enchanting. At its fountain head it is nothing more than a small vein of water, oozing from a hill on a bed of sand or clay, on which account it has been supposed to originate in waters brought from the sea by subterraneous ducts, and having lost their saltness by percolation in their passage through the earth. If this be conceded, it is not so easy to explain by what power the water rises above the level of the sea to the summits of mountains, where springs generally abound; it being contrary to the laws of hydrostatics that a fluid should rise in a tube above the level of its surface. Doctor Halley has on this subject ventured an hypothesis which has been most generally received. He attributes the origin of springs to vapours raised by the action of the sun, as well as by the agitation of the winds, from seas, lakes, &c. He made several experiments to show that vapour is a sufficient fund to supply all our rivers, springs, &c. To find the quantity of water which the Mediterranean receives, he allows the most considerable rivers which run into it, such as the Iber, Rhone, Tyber, Po, Danube, Neister, Boristhenes, Tanais, and Nile, each to furnish ten times as much water as the Thames, including in this estimate the water which flows into that sea from the small rivulets. Now the Thames is found by calculation to evacuate two hundred and three millions of tons of water daily. The above nine rivers, will, therefore, evacuate little more than eighteen millions of tons in a day; and this scarcely exceeds a third of what he had, by preceding experiments, demonstrated to be raised in that time in the form of vapour. He has thus discovered a source abundantly sufficient for the supply of fountains.

To explain this theory on the principles of evaporation, the Doctor considers that if an atom of water were to be expanded into a bubble, so as to be ten times as large in diameter as when it was in its condensed state of water, that atom would become specifically lighter than the air, and would, therefore, rise so long as the warmth which first separated it from the surface of the water should continue to distend it in the same degree; and, consequently, that vapours may be raised from the sea in that manner, till they arrive at a certain height in the atmosphere, in

which they find air of equal specific gravity with themselves. Here they will float, till, being condensed by cold, they become specifically heavier than the air, and fall down in dew; or, being driven by the winds against the sides of mountains, many of which far exceed the usual height to which vapours would of themselves ascend, are compelled by the stream of air to mount up with it to their summits. Being there condensed into water, they presently precipitate, and, oozing down by the crannies of the stones, enter in part the crevices of the hills. These being once filled, all the overplus of water which comes thither, runs over by the lowest place, and breaking out by the sides of the hills, forms single springs. Many of these running down by the vallies, between the ridges of the hills, and uniting, form little rivulets or brooks. Many of these again meeting in one common valley, and, by gaining the plain ground, having grown less rapid, become a river; and many of these uniting, form such prodigious streams of water as the Wolga, the Danube, and the Rhone.

Thus, one part of the vapours which is blown on the land is returned, by the rivers, to the sea whence it came. Another part falls into the sea before it can reach the land, which is the reason why the rivers do not return so much water into the Mediterranean as is raised by vapour. A third part falls on the low ground, and furnishes the pabulum, or nutriment of plants. But the circulation does not end even here; for it is again exhaled into vapour by the action of the sun, and returned to the great world of waters whence it first arose.

To this theory, beautiful as it appears, it has been objected that it does not account for the origin of hot and salt springs, and that many springs, among which is a remarkable one at Upminster, in Essex, are not only perpetual, but yield the same quantity of water, whatever proportion of rain or vapour may be afforded. Amid these uncertainties, the exclamation of the apostle Paul may be aptly cited: "*O the depth of the riches both of the wisdom and knowledge of God! How unsearchable are his judgments, and his ways past finding out?*"

AMERICAN RIVERS.

Nor less thy world, Columbus, drinks refresh'd
The lavish moisture of the melting year.
Wide o'er his isles, the branching Oronoque
Rolls a brown deluge; and the native drives
To dwell aloft on life-sufficing trees,
At once his dome, his robe, his food, and arms.
Swell'd by a thousand streams, impetuous hurl'd
From all the roaring Andes, huge descends
The mighty Orellana. Scarce the muse
Dares stretch her wing o'er the enormous mass
Of rushing waters; scarce she dares attempt
The sea-like Plata—to whose dread expanse,
Continuous depth, and wond'rous length of course,
Our floods are rills. With unabated force,
In silent dignity they sweep along,
And traverse realms unknown, and blooming wilds,
And fruitful deserts, worlds of solitude,
Where the sun shines, and seasons teem in vain,
Unseen and unenjoy'd.

THOMPSON.

RIVER OF THE AMAZONS.

This prince of rivers, as it is emphatically styled by Ulloa, is likewise called the Maranon, and was first navigated by Francisco Orellana, shortly after the discovery of Peru, on which account it has occasionally received the name of Orellana. As it is the largest of all known rivers, so it has its source among the Andes mountains, which, with the exception of a portion of the great Himalaya chain of Asiatic mountains, recently discovered, have the greatest elevation. It forms the northern boundary of Brazil, taking its rise at an inconsiderable distance from the Pacific Ocean, and flowing in an eastern course more than twelve hundred leagues, in which progress it receives upwards of sixty considerable rivers. In some parts it divides into several branches, encompassing a multitude of islands, and at length discharges itself into the Atlantic Ocean, directly under the equatorial line, by a channel one hundred and fifty miles in breadth.

As, among the great number of roots by which nourishment is conveyed to a stately tree, it is difficult, from the length of some, and the magnitude of others, to determine

precisely that from which the product is derived: so has an equal perplexity occurred in discovering the spring of this transcendant river. All the provinces of Peru may be said to emulate each other in sending forth supplies for its increase; and these, together with the many torrents which precipitate themselves from the cordilleras, or chains of the Andes, augmented by the snow and ice, join to form a kind of sea of what at first scarcely deserved the name of a river.

The sources by which this river is increased are so numerous, that every one which issues from the eastern cordillera, beginning with the government of Popayan, where the river Caqueta, or Upura, originates, to the province of Huanico, within thirty leagues of Lima, the capital, may be strictly reckoned among the number. For, be it observed, all the streams which run westward from this immense chain of mountains, widening as they advance from their source by the conflux of others, form those mighty rivers which afterwards unite in that of the Amazons; and, although some traverse a larger distance from their source, still, others which rise nearer, by receiving in their short course a great number of brooks, and by consequently discharging a proportionate quantity of water, may be considered as having an equal claim to be called the principle source. The authors of the Peruvian Mercury, whose profound enquiries on this subject have been given in the work entitled "The present state of Peru," regard, however, the Ucayali as its real trunk, observing, among other cogent reasons, that it does not yield to this river in the quantity of its waters; but, on the contrary, presents itself at the confluence with a greater breadth, and with a superiority which obliges it to change its course. This will be best explained in treating of the Apurimac, the name bestowed on the Ucayali at its origin.

The Maranon, or river of the Amazons, issues from the lake of Lauricocha, near the city of Huanico, in the jurisdiction of Tarma, in eleven degrees of south latitude, whence it takes a southern course almost to the twelfth degree, through the country belonging to that jurisdiction, and, forming insensibly a circuit, flows eastward through the country of Juaxa. After being precipitated from the eastern side of the cordillera, or chain, of the Andes, it proceeds northward; and, leaving the jurisdictions

of Mayabamba and Chacha-poyas, continues its course to the city of Jaen, in the latitude of five degrees, twenty-one minutes. Thence, by a second circuit, it flows towards the east in a continued direction, till at length it falls into the ocean, where its mouth is of such an enormous breadth, that it reaches from the equinoctial to beyond the first degree of north latitude. Its distance from the lake of Lauricocha to Jaen, including its windings, is about two hundred leagues; and that city being thirty degrees to the west of its mouth, gives a further extent of six hundred leagues, which may, including the several circuits and windings, be moderately computed at one thousand. Thus, the whole course of this transcendant river, from Lauricocha to its influx into the ocean, is at least twelve hundred leagues.

THE APURIMAC.

This river has its source in the wild heaths of Condoroma, in the province of Tinta, in sixteen degrees of south latitude. It flows impetuously to the east towards the Cordillera of Vilcanota, to the distance of three leagues, when, suddenly shifting its course to the west, it divides that Cordillera from the province of Chumbibilcas. It now enters the provinces of Aimaraes and Cotabambas, and directs its rapid course to the north-west, leaving to the east the province of Cusco. In passing through that of Abancay, it declines to the north-east, by which direction it forms, from its primitive source, an arc that receives so many torrents on either side, as to prevent it from being longer fordable. Determining its career to the north, two leagues below the bridge of Apurimac, it forces its passage through the lofty territory of the Andes, running between mountains of incredible elevation, by which it is supplied with abundant waters. In thirteen degrees, ten minutes, the river of Cocharcas, or Pampas, which descends from the heights of Huancavelica, flows into it to the west. The Apurimac continues its course, collecting the waters poured down from the mountains of Guanca; and is joined to the east, in twelve degrees, fifteen minutes, by the river Quillambamba, or Vilcamayo. In twelve degrees, six minutes, it is joined to the west by the river of Jauxa, named by the Indians Mantaro; when, taking a bend to the the north-east, in eleven degrees, eighteen minutes, the Perene incorporates itself

with its mass of waters. This latter river originating within two leagues of Tarma, divides that city, and receives various streams from the Cordillera of Bombon, and from Pasco.

From the confluence of the Perene to that of the Pachitea, forty capacious rivers empty themselves into the Apurimac. Of the two which are of particular note, the one that flows into it on the eastern side, in ten degrees forty-five minutes, is the Paucartambo; and the other, which disembogues three leagues below, with such an impetuosity as to propel it against the mountains, and to cause it to change its direction to the north-west, is the Beni. The former of these rivers is the celebrated Amarumayu, by which the Ynca Yupanqui entered, in undertaking the conquest of the tribes of Moxas Indians—an enterprise which was afterwards meditated by Alvarez Maldonado. It originates on the heights of Cusco, and enters with a quantity of water greater by the one half than that which the Apurimac contained before its confluence. After this junction, the latter acquires the name of Apo-paru, or Gran-Paro; and continuing its impetuous course in the same direction as before, is augmented, in eight degrees, twenty-six minutes, by the waters of the Pachitea. It now becomes the formidable rival of the river of the Amazons, and receives the name of Ucayali, by which it is henceforward distinguished. Taking a declination, in its progress, from the north to the north-east, at the western bank, at which it receives the Pachitea, the following rivers pay it tribute: the Aguaitia; the Manoa, or Cuxhiabatay; the Sarayacu; and the Tapichy Cano Pocati, which communicates with the river of the Amazons in front of the town of San Regis, in five degrees. A bay which occupies an extent of territory for three leagues, having been formed, it divides into three branches; and finally falls in with the river of the Amazons, in four degrees, forty-five minutes, causing it to change its impetuous course.

THE OROONOKO.

This celebrated river lies in the jurisdiction of Popayan, and falls into the sea by sixteen mouths. It communicates with the river of the Amazons by the Negro, one of the formidable branches (the eastern) of the river Caqueta. Its western branch, named Yupura, disembogues itself into

the river of the Amazons like another Nile, through seven or eight mouths, and these at such a distance from each other, that the intermediate space between the first and the last is not less than a hundred leagues. M. de la Condamine, in the narrative of his voyage, confirms the opinion of the Negro being one of the communications between the Oroonoko and the river of the Amazons, and corroborates his assertion by the following anecdote, related by a jesuit who published a map of these rivers. In the year 1744, a flying camp of Portuguese, posted on the bank of the river Negro, having embarked on it, proceeded until they found themselves near the Spanish missions of Oroonoko, and, meeting with the superior of these missions, returned with him to the flying camp they had quitted, without going one step by land. Here then is a communication by water between the Spanish and Portuguese possessions in South America, placed at so vast a distance, which demonstrates the magnitude and extent of these mighty rivers.

The Oroonoko, although it fails in comparison with several other rivers of the new world, far surpasses the largest rivers of our hemisphere. It rolls toward the ocean such a vast body of water, and rushes into it with such impetuous force, that when it meets the tide, which on that coast rises to an uncommon height, their collision occasions a swell and agitation of the waves no less surprising than formidable. When Columbus in his third voyage, having taken a more southern course than he had pursued in the former ones, reached the island of Trinidad, the swell occasioned by the waters of this river pouring into the ocean was so great, that his ships were exposed to extreme danger. After having however, long combated the currents and tremendous waves with dubious success, he led his squadron safely through a narrow strait which separates that island from the continent. This strait he called "*Bocca del Drago*," the Dragon's Mouth. Justly concluding that such a vast body of water must flow through a country of immense extent, and that he was now arrived at that continent it had long been the object of his wishes to discover, he stood to the west, along the coast of those provinces, now known by the names of Paria and Comana.

RIO DE LA PLATA.

This vast river, like those already described, rises among the stupendous mountains on the western side of South America. During its course, which is said to exceed eight hundred leagues, it receives upwards of fifty rivers, and at length discharges itself into the Atlantic ocean by a very extensive mouth, its northern coast being in thirty-five degrees, and its southern in thirty-six degrees, twenty minutes, of south latitude. It was discovered, in 1515, by Don Diaz de Solis, a very skilful Spanish navigator, who had been sent to open a communication with the Moluccas, or Spice Islands, lying to the west. Having entered a river which he called Rio Janeiro, and which has since given a name to the Brazilian capital, he proceeded thence to a spacious bay, which he supposed to be the entrance of a strait communicating with the Indian ocean. On advancing further, however, he found it to be the mouth of this river; and, being anxious to prosecute his discovery, was cut off, with several of his crew, by the natives. Being thus disheartened, the survivors returned to Europe, without having made any further attempt to explore the territory.

P. Cataneo, a Modenese jesuit, who landed at Buenos-Ayres in 1749, expresses his astonishment at viewing this vast body of water. "When," he observes, "I resided "in Europe, and read in books of history or geography "that the mouth of the Rio de la Plata was a hundred and "fifty miles in breadth, I considered it as an exaggeration, "because in this hemisphere we have not any example of "such vast rivers. When I approached its mouth, I had "the most vehement desire to ascertain the truth with my "own eyes; and I have found the matter to be exactly as "it was represented. This I deduce particularly from one "circumstance. When we took our departure from "Monte-Video, a fort situated more than a hundred miles "from the mouth of the river, and where its breadth is "considerably diminished, we sailed an entire day before "we discovered the land on the opposite bank of the river; "and when we were in the middle of the channel, we "could not discern land on either side, and saw nothing

"but the sky and water, as if we had been in some great "ocean. Indeed, we should have taken it to be the sea, "if the freshness of its water, which was turbid like that of "the Po, had not satisfied us that it was a river. Moreover, "at Buenos Ayres, another hundred miles up the river, and "where it is still much narrower, it is not only impossible "to discern the opposite coast, which is indeed, very low "and flat, but one cannot perceive the houses, or the tops "of the steeples, in the Portuguese settlement at Colonia, "on the other side of the river."

It has been asserted that most of the rivers of Peru and Chili have scarcely any motion by night, while on the appearance of the morning sun, they resume their former rapidity. This would appear to proceed from the mountain snows, which, being melted by the powerful heats, increase the stream, and continue to drive on the current, while the sun is engaged in dissolving them. Thus are formed these wonderful masses of water!

In concluding this account of the rivers of South America, the prodigious multitudes and variety of the fishes with which they abound, ought not to be passed over unnoticed.

In the river of the Amazons, agreeable to the testimony of the Jesuit Acugna, they are so abundant, that, without any art they may be readily taken with the hands. "In "the Oroonoko," observes another Jesuit, Gumilla, beside "an infinite variety of other fishes, turtles abound in such "numbers as words cannot be found to express. I doubt "not but that such as read my account will accuse me of "exaggeration: but I can affirm, that it would be as diffi-"cult to count them, as to count the sands on the banks "of that river. Their multitude may be estimated by the "surprising consumption of them; for all the nations con-"tiguous to the river, and even many dwelling at a dis-"tance, flock thither at the breeding season, and not only "find sustenance during that time, but carry off great num-"bers both of the turtles, their eggs, &c."

THE MISSISSIPPI.

Proceeding to North America, this vast river claims the principal attention. It runs chiefly from North to South, receiving in its course many large rivers, scarcely inferior to the Rhine or the Danube, navigable almost from their

sources, and laying open the inmost recesses of this part of the great American continent. Near the heads of these are extensive lakes, having a communication with each other, and with the great river St. Lawrence.

The Mississippi is supposed to take its rise from three or four springs which unite at about forty-six degrees of north latitude, and ninety-eight of west longitude. It has been ascended as high as forty-five degrees North, about one hundred and fifty miles above the FALLS OF ST. ANTHONY. Its course extends above two thousand miles, comprising its continual flexions. In a south-east direction, it proceeds till it reaches about thirty-eight degrees of north latitude; and then takes a course almost due south, till it arrives at West Florida, where it again runs to the south-east. On the westward, near the falls of St. Anthony, it receives the river St. Pierre, or St. Peter; and in the same direction, in about forty-one degrees of north latitude, the Moingona; receiving from the eastward the Fox river, and the Illinois, below forty degrees. A little lower, the noble Missouri runs into it from the westward, the Ohio joining it from the eastward. At thirty three degrees the White River and the Paniassas first join, and then pour their united streams into this grand receptacle of waters, which discharges itself into the sea by many openings.

This grand river, after being joined by the Missouri, is about six miles in width, and continues its course southernly, not any considerable stream falling into it, after the above, for between two and three hundred miles, when it is joined by the Ohio. The country on each side the Mississippi to this part is exceedingly fine, and the climate warm and agreeable.

The navigation of the Mississippi is very tedious, even in descending, as it is not deemed safe to sail down it during the night, the channel being constantly encumbered by floating trees, which the winds tear from its banks, and precipitate into the water. The ascent is still more difficult and tedious. Proceeding northward from its mouth, the adjacent country is one continued level spot, covered with vast forests, which so entirely intercept the winds as to cause a dead calm constantly to prevail, insomuch that, in this part it usually requires a month to navigate twenty leagues only. When these forests cease, the remainder of

the navigation is obstructed by strong currents, so that boats seldom advance farther than five or six leagues in the course of a day and night. This river bounds Louisiana to the eastward; and at its mouth is the isle of Orleans, a very beautiful and fertile spot. The city of New Orleans, the capital, owed its rise to the delusions which were practised on the French nation by the celebrated projector Law. The immense wealth which was supposed to be contained in the mines of St. Barbe, in Louisiana, caused a company to be formed in France; and the national phrensy, which was long prevalent, led vast numbers to embark, for the purpose of settling on the banks of the Mississippi. Being landed in West Florida, the greater part perished through want; and the survivors were removed to this island, where the city of New Orleans was built for their accommodation.

THE OHIO.

This river rises in several branches, some of which have their source in the vicinity of Lake Erie, and others within a few miles of Lake Ontario. It is also denominated the "Fair river," and is styled by Mr. Jefferson, late President of Congress, "the most beautiful river on earth." Until it is joined by the Monongahela, it is named the Alleghany, the former rising from the west side of the Alleghany mountains, in a great number of small streams, which unite, and, together with the Alleghany, form this river, in forty degrees, thirty-five minutes north latitude. Receiving now the name of the Ohio, its general course afterwards inclines to the south-west, and takes a remarkably winding serpentine form. At Fort Pitt, where the junction is made, it is little more than a mile in width, but becomes much wider before it joins the Mississippi, in latitude thirty-six degrees, eight minutes, north, receiving several streams in its course thither. Between the lakes and this latter junction, the country for several hundred miles has a delightfully variegated scenery, and a rich soil.

This river is not, any more than the Mississippi, acted on by tides, the copious efflux causing the waters constantly to proceed with rapidity toward the mouth, so that ships cannot, without great difficulty, navigate upward. The commercial benefits which these rivers yield are on that

account chiefly internal, a ready conveyance being furnished for the export of the productions of the country, but with an incapacity to bring back foreign produce in return. In the rising state of Kentucky many ships are built, which, floating down the Ohio, proceed to the gulf of Mexico, and, taking the benefit of the current which constantly sets in to the northward, through the straits of Bahama, reach their destined port on the eastern coast of North America, with great safety and celerity. One material impediment, however, to this navigation on the Ohio, is a considerable fall, about the latitude of thirty-eight degrees north. This fall has, however, a gradual descent, which is continued for half a league. There is a considerable variation in the quantity of water which fills the bed of this river at different seasons of the year; and when it becomes shallow, the depth of water at the fall, barely suffices to convey light boats down the stream.

THE SAINT LAURENCE.

The source of this great Canadian river has never been traced, although it is known to have communication, by the lakes, with the interior of the country, to a vast extent. After a north-eastern course of many hundred miles, it discharges its waters into a large gulf, extending from forty-five degrees, thirty minutes, to fifty-one degrees of north latitude; the islands of Newfoundland and Cape Breton lying between it and the great Atlantic ocean. It is navigable for large ships as high as Quebec, four hundred miles from its mouth; but higher up, the navigation is impeded by rocks and shoals. The difficulties and dangers attendant on it were greatly exaggerated by the French, while in possession of Canada; but since the latter has become a British colony, the utmost attention has been bestowed to form accurate charts of this river, and to afford every aid to its safe navigation. In executing these designs, the immortal Cook was for some time employed, before he became a circumnavigator; and the abilities he then displayed, laid the foundation of his future fame.

The other North American rivers, however inferior to those already described, and to those of South America, are still on the grand scale by which the face of that continent is so pre-eminently distinguished. On the eastern

side, are the fine rivers HUDSON, DELAWARE, JAMES, POTOMAC, SUSQUEHANNA, CONNECTICUT, and several others of extensive length, and great depth. Those which flow westward, and discharge themselves into the Pacific ocean, are but imperfectly known: the OREGAN, likewise called the COLUMBIA, or RIVER OF THE WEST, is supposed to be the largest, and, so far as it has been traced, has been found to be of such a breadth and depth, and so rapid, as to lead to a conjecture that it takes its rise in the central part of the American continent.

The DELAWARE, the largest river in the state of Pennsylvania, rises in the country of the five nations, and flows into the sea at Delaware bay. It is navigable for nearly a hundred and fifty miles, when falls occur. The settlements on this river extend a hundred and fifty miles from the city of Philadelphia, which is seated to the westward, on its bank, and to the eastward on the Schulkill, which the Delaware joins a few miles below Philadelphia. The SUSQUEHANNA rises in the same state, at the distance of ninety miles from the Apalachian mountains, and runs at first south-west, and then south-east, nearly parallel to the Delaware, till it discharges itself into Chesapeak bay, in Maryland. This river is likewise navigable to a very great distance in the interior of the country, and, if possible, exceeds the other in the pleasantness and fertility of the soil on its banks. The SCHULKILL, already mentioned, runs parallel to the other two rivers, and is navigable for at least a hundred miles in the interior. These rivers, with the numerous bays and creeks in Delaware bay, which is capable of containing the largest fleets, render this province admirably suited for carrying on a foreign trade.

On the side of Virginia, JAMES RIVER, YORK RIVER, the RAPPAHANOCK, and the POTOMAC, flow into the bay of Chesapeak, which is enriched throughout its whole extent by a vast number of fine navigable rivers. This bay is one of the finest and largest in the known world; for it enters the country nearly three hundred miles from the south to the north, having the eastern side of Maryland, and a part of Virginia, on the same peninsula, to shelter it from the Atlantic ocean. Its breadth for a considerable distance is nearly eighteen miles, and seven where it is narrowest.

The above rivers are not only navigable to a very considerable extent, but have so many creeks, and receive such a number of smaller navigable rivers, as to render the communication to all parts of the country inconceivably easy. The Potomac is navigable for nearly two hundred miles, being nine miles in breadth, at its mouth, and not less than seven for a very considerable distance. The other three rivers are navigable upwards of eighty miles; and in their windings approach so near to each other, that the distance between them in some parts is not more than five miles, and in others does not exceed ten.

The CONNECTICUT rises in the state of New Hampshire, in forty-five degrees of latitude, and pursues a remarkably straight course to the south, discharging its waters into the sound opposite Long Island. About one hundred and forty miles from its source, are the rapids, or falls, occasioned by the water being enclosed by two rocks within a space of about thirty feet, and falling into a broad bason beneath. Over these rocks a bridge has been thrown with such an elevation as to be inaccessible to the highest floods.

HUDSON'S, or the NORTH RIVER, rises within about twenty miles of LAKE GEORGE, and, running to the south, discharges itself at Sandy Hook, the entrance of the river of New York. It is navigable for vessels of a moderate burden as high as Albany, a distance of one hundred and fifty miles.

ASIATIC RIVERS.

THE GANGES.

BOTH in magnitude and extent the Ganges is a most noble and majestic river. It rises in the kingdom of Thibet; entering Hindostan about the thirtieth degree of latitude, and runs first south-eastward by the cities of Bekaner, Minapor, Halabes, Benares, and Patna, to Rajah Mahl, where it divides into two branches. The eastern having passed by Dakka, the capital of Bengal, enters the gulf of that name about Chatigan. The western, descending by Kossum-bazar and Hughly, falls into the gulf below Chandernagor towards Pipeli. Many of the Jews, and

ancient Christians believed this river to be the Pison, one of the four mentioned in Scripture as the boundaries of the terrestrial paradise.

The length of the Ganges exceeds fourteen hundred miles. The Burrampooter, its proudest auxiliary, is nearly of the same length; and the opinion generally entertained, is, that the sources of these mighty rivers are not far distant from each other. Each of them runs, however, nearly a thousand miles, before they unite and constitute one common stream, falling into the bay of Bengal by several mouths. Ganga is, in the Hindostan language, a general term for a river; but it is particularly applied to this one on account of its unrivalled magnificence. The Hindoos have a superstitious veneration for all the great rivers which fertilize their country; but the waters of the Ganges are to them peculiarly sacred. In its impetuous course it opens a passage through Mount Himmeleh, and again appears, amidst impending rocks, which resembling, on an immense scale, the head of a cow, an animal equally esteemed by the Hindoos, as was the apis, or sacred ox, among the Egyptians, their religious awe for the Ganges is, on that account, enhanced. Not any river in the world imparts greater benefits to the countries through which it passes; for, by annually overflowing its banks like the Nile, it waters and manures the country to an extent of an hundred miles in breadth. The Hindoos having deified this river, make it an act of their religion to perform a pilgrimage to it, supposing its waters to purify from defilement such as bathe in them. On its slimy shore they bury their dead, and also remove those who are at the point of death to its banks, or to those of some one of the creeks which run into it.

On certain festivals, a concourse of upwards of a hundred thousand persons assemble to bathe in the Ganges, on the banks of which are a great number of superb and immensely rich pagodas. But what principally distinguishes this river, besides its greatness and rapidity, is the gold it brings down in its sands, and throws on its banks; and the precious stones and pearls it produces, not only in itself, but in the Gulf of Bengal, into which it discharges its waters, and which abounds with them. The Chun, or Jemma, the Guderasu, the Persilis, Lakia, and

several other rivers, discharge themselves into it during its course.

THE INDUS.

This river is by the natives called Sinde or Sindet, and in the Sancrit language Seendho. It is likewise denominated Nilab, or the blue river. Its source has not been accurately traced; but it is generally supposed to originate in the mountains of Mus Tag, running from east to west, and forming a chain to the south of little Bucharia. Having flowed for an extent of upwards of a thousand miles, it forms a Delta in the province of Sinde, and enters the Indian Sea by numerous mouths.

The tributary streams of the Indus chiefly join it in the northern part of its course, where they form the Panja, or county of five rivers. From the west, the Kamet, with its auxiliary streams, and the Comul, flow into it; from the east, the Behut, or Hydaspes; the Chunab, or Acesinas; the Kaavee, or Hydraotes; and the Setleg, or Hesudrus. The whole of this part of Hindostan is at present but little known: much is, however, expected from the indefatigable researches of the members of the Asiatic Society. It is even uncertain whether the Caggan, a considerable and distant river to the east, joins the Indus, or falls into the gulf of Cutch.

Mr. Elphinstone, in his account of the kingdom of Caubul, introduces the following interesting account of the Indus:—

"We were anxious and happy as we approached the river, and were not a little gratified when at last we found ourselves upon its banks. The Indus, besides its great name, and the interest it excites as the boundary of India, is rendered a noble object by its own extent, and by the lofty hills which form the back-ground of the view.— We were, however, a little disappointed in its appearance, owing to an island, which divided it, and impaired the effect of its stream. There were other islands and sandbanks in the river; but near the side where we stood, it came up to the edge, and seemed deep and rapid. While on the banks of the river, we met a native, to whose conversation, and that of the guide, we listened with great

interest and curiosity. The plains on the opposite shore we found were inhabited by Beloches, and the mountains by the Sheeraunees, a fierce and turbulent tribe. On the other side of the range were tribes and places, of which we had never heard the names; while those we had learned from our maps, were equally new to our informants. All we could learn was, that beyond the hills was something wild, strange, and new, which we might hope one day to explore.

"From Oodoo da Kote, near which we first saw the Indus, to the ferry of Kaheree, where we crossed it, is about seventy-five miles. It is a narrow tract, contested between the river and the desert. If, in hunting, we were led many miles to the west of the road, we got into branches of the river, and troublesome quicksands, among thickets of tamarisk or of reeds; and, if we went as far to the right, the appearance of sand, and even in some places of sand hills, admonished us of the neighbourhood of the desert. Many parts, however, were cultivated with great pains and method, and produced good crops of wheat, barley, turnips, and cotton. The fields were always enclosed, either with hedges of dry thorn, with hurdles of willow, or with fences, made of stiff mats of reeds supported by stakes. Some of the houses near the river attracted our attention, being raised on platforms, supported by strong posts, twelve or fifteen feet high. We were told they were meant to take refuge in during the inundation, when the country for ten or twelve coss (twenty or twenty-four miles,) from the banks was under water."

Besides the above majestic rivers, those principally deserving of notice in the Asiatic territory are the following.

The Euphrates, which has two sources: one of these is about seventy miles from the shores of the Euxine or Black Sea, and, taking a circuitous course of five hundred leagues, first to the south-west, and then to the south-east, discharges itself into the Persian gulf. About a hundred miles to the north-west of Bassora it is joined by the Tigris, which, rising in its vicinity, proceeds in a nearly straight course through Armenia Major, or Turcomania, until it forms its junction. On this river the ancient city of Ninevah is supposed to have stood. The Kistna, a stream peculiarly sacred, rises at Balisur,

not far to the south of Poonah, and is equally celebrated for the fertility it diffuses, and for the rich diamond mines near which it flows, particularly those of Visiapour and Golconda. The CAVERY passes by Seringapatam, the capital of Mysore, forming an immensely wide Delta, or triangle, and entering the sea after a course of about three hundred miles.

In the enormous extent of the Chinese Empire there are two rivers which are rendered particularly interesting by their great length and majestic breadth. These are the Hoang-ho, or Yellow River, and the Kian-ku.

THE HOANG-HO.

THE sources of this river are two lakes, situated in the chain of the Tartarian mountains, known by the name of Kohonor. They lie in about the thirty-fifth degree of north latitude, and in the nineteenth of longitude, to the westward of Pekin, and in ninety-seven degrees east of Greenwich. This prodigious river is extremely winding, and deviates in its course, pursuing a north-east direction to about the forty-second degree of north latitude; when, after running due east, it suddenly bends south to a latitude nearly parallel to its source, and pursues an easterly direction till it is lost in the Yellow Sea. Its course may be estimated at about one thousand eight hundred British miles, or, according to the embassy of Lord Macartney, two thousand one hundred and fifty. At the distance of about seventy miles from the sea, where it is crossed by the Imperial canal, its breadth is little more than a mile, with the depth of a few feet only; but its velocity is equal to seven or eight miles an hour.

THE KIAN-KU.

THIS river rises in the vicinity of the sources of the Hoang-ho, but about two hundred miles further to the west, and winds nearly as far to the south as the latter does to the north. After washing the walls of Nankin, it enters the sea about a hundred miles to the south of the Hoang-ho. Through its long progress, the Kian-ku is known by various names. Its course is nearly equal to that of the other river, these two being considered as nearly if not altogether, the longest on the face of the globe. They

certainly equal, if they do not exceed, the famous river of the Amazons in South America: the majestic course of the Ganges does not exceed half their length. In the narrative of Lord Macartney's embassy, the extent of the Kian-ku is estimated at about two thousand two hundred miles; and it is there observed that these two great Chinese rivers, taking their source from the same mountains, and passing almost close to each other in a particular spot, when they separate to the distance of fifteen degrees of latitude, or about one thousand and fifty British miles, finally discharge themselves into the same sea, comprehending a tract of land of about a thousand miles in length, which they greatly contribute to fertilize.

AFRICAN RIVERS.

THE NILE.

——with annual pomp,
Rich king of floods! o'erflows the swelling Nile.

THOMSON.

THIS celebrated river is likewise called Abanchi, signifying in the Abyssinian tongue "the father of rivers," and is named by the Africans Neel Shem, the Egyptian river. It divides Egypt into two parts; and its extent, from its source, is supposed to exceed two thousand miles. It arises from amidst the mountains of the moon, in Upper Ethiopia, and flows into the Mediterranean sea by seven channels, two only of which are at present navigable. The ancients were entirely ignorant of the source of this river, although many endeavors were made by them to explore it; but it is now well known to lie in about the twelfth degree of north latitude. It enters the lake of Dambia, in Abyssinia, crossing one of its extremities with such extreme rapidity, that its waters may be distinguished through a progress of six leagues within this lake. Here its magnificence commences: after a further progress of about fifteen miles, it rushes precipitately from the summit of a high rock, forming one of the most beautiful waterfalls known. It now again collects its scattered streams among the rocks, which seem to be disjointed in that part

merely to afford it a passage. They are so close to each other, that a bridge of beams was once laid over them to afford a passage to an army; and Sultan Segued built over them a bridge of one arch, to construct which he procured masons from India.

The greater part of Lower Egypt is contained in a triangular island, formed by the Mediterranean Sea, and the two great branches of the Nile—which dividing itself five or six miles from Old Cairo, flows on the one side to the north-east, falling into the sea at Damietta; while the other branch runs to the north-west, and enters the sea at Rosetta. What is called the Delta, resembling the Greek letter of that name, and constituting a triangle, is thus formed.

The water of the Nile is thick and muddy, more particularly when the river is swollen by the heavy rains which constantly fall within the tropics in the beginning of the summer-season, and which are doubtless the principal cause of its overflowing the low lands of Egypt. A similar phenomenon in the Ganges has been noticed above; and it is the same with all the rivers which have either their rise or course within the tropics; they annually break their bounds, and cover the lands for many miles on each side, before they reach the sea. They likewise leave prolific mud, which, like that of the Nile, fertilizes the land; beside which, the north winds prevailing about the latter end of May, drive in the waters from the sea, and keep back those of the river, in such a manner as considerably to assist the swell.

The Egyptians, and the Copts more especially, are persuaded that the Nile always begins to rise on the same day of the year; as, indeed it generally commences on the 18th or 19th of June. Its rise was observed for three successive years by Dr. Pococke, who found it to ascend during the first five days from five to ten inches; and it thus continued rising till it had attained the height of nine feet, when the canal of Cairo was cut. It then rose from three to five inches only in the day; for, having spread over the land, and entered the canal, although more water might have descended than before, its rise was less considerable. The other canals were now laid open at stated times, and those which water the lower grounds the last. These canals are carried along the highest parts of the coun-

try, to the end that the water may be conveyed to the vallies.

The Nile has one peculiar characteristic. Other rivers being supplied by rivulets, the ground is lowest near their banks; but as not any water flows into the Nile in its passage throughout Egypt, and as it is necessary that this river should overflow the land, the country is generally lower at a distance from, than near to it; and, in most parts, the land has a gradual descent from the river to the foot of the hills, which terminate the sandy plains most benefitted by the irrigation.

Among other remarkable appearances, the celebrated Bruce notices a very singular one attendant on the inundation of the Nile. In Abyssinia, the early part of the morning is constantly clear in that season, with a fine sunshine. About nine, a small cloud, not above four feet in apparent breadth, appears in the east, whirling violently round as if on an axis; but having approached nearly to the zenith, it first abates its motion, and then loses its form, extending itself greatly, and seeming to call up vapours from all the opposite quarters. The clouds thus formed having attained nearly the same height, rush against each other with great violence, and remind the spectator of Elisha foretelling rain on Mount Carmel. The air being impelled before the heaviest mass, or swiftest mover, makes an impression of its form on the collection of clouds opposite; and the moment it has taken possession of the space made to receive it, the most violent thunder possible to be conceived follows instantly, attended by rain. After some hours the sky again clears, with a wind at north; and it is always disagreeably cold when the thermometer is below sixty-three degrees.

Dr. Clarke, in his travels, draws the following elegant picture of this most interesting river.

"Here we were unexpectedly greeted with an astonishing view of the Nile, the Delta, and the numerous groves in the neighbourhood of Rosetta. The scene is beyond description. The sudden contrast it offers, opposed to the desert we had traversed, the display of riches and abundance poured forth by the fertility of this African paradise, with all the local circumstances of reflection excited by an extensive prospect of the Nile, and of the plains of Egypt, render it one of the most interesting sights in the world.

The beautiful boats peculiar to the Nile, with their large wide-spreading sails, were passing up and down the river. Unable to quit the spot, we dismissed our guides, and remained some time contemplating the delightful picture. Afterwards, descending on foot, close by the superb mosque of Abu-mandur, we continued our walk along the banks of the Nile, through gardens richer than imagination can pourtray, beneath the shade of enormous overhanging branches of sycamore and fig trees, amidst bowers of roses, and through groves of date, citron, lime, and banana trees, to Rosetta.

THE SENEGAL.

Next to the Nile, this is the most remarkable river in Africa. It takes its rise from the western declivity of the mountains of Govina, or Caiphas, in fourteen degrees of north latitude, and nearly on the meridian of Greenwich. From the eastern declivity of these mountains, the Niger takes it rise, and may, therefore, be comprehended in this description. The Africans navigate both these rivers; and, where the cataracts occur in the former, carry their goods by land. A trade is carried on by small vessels as high as the first cataract of the Senegal, two hundred and eighty leagues from its mouth, at which it is extremely rapid, owing to an immense body of water being confined within the small breadth of half a league. There is also at the entrance a bar, which renders the passage very difficult and dangerous, especially in the rainy season, when the prodigious swell of the river, and the south-west winds, being opposed to its rapid course, raise waves of so prodigious a height at the bar, that their clashing resembles the shock of mountains, and they are said to be so furious as occasionally to dash in pieces the stoutest ships. Having crossed the bar, a smooth and gently-gliding river is entered, four fathoms in depth. It takes a western course, tending somewhat to the northward, through sixteen degrees of longitude, and, including its bendings, extends upwards of eleven hundred miles.

The Senegal has been supposed to be a continuation of the Niger; but it is now thought that the latter discharges its rapid stream into a lake not more than sixty miles distant from another lake of great depth, called Maberia, whence

issues one of the sources of the Senegal. These two lakes are intersected by a ridge of very high mountains.

These two rivers have, like the Nile, their inundations, which overspread the whole of the flat country of Nigritia. They begin and cease much about the same time as the latter overflows; but the salutary effects experienced in Egypt are not to be found here; for, instead of health and plenty, diseases, famine, and death, follow in their train. The soil thrown up by the Senegal, becomes, through the indolence of the savage wanderers who occupy its banks, useless to any agricultural purpose; and the country lying untilled, produces from its luxuriance great abundance of rank and noxious herbage, furnishing a convenient repository for venomous insects and reptiles, as well as for beasts of prey. When the waters of these rivers retire into their channels, the humidity and heat which prevail spread a pestilential taint; while the carcases of vast numbers of animals, swept away by the inundation, become putrid, and spread around a loathsome and baneful stench.—Even the vegetation itself is charged with destruction; for among the plants which grow on the banks of the Senegal, some diffuse an insufferable and deleterious odour.

THE GAMBIA.

This river lies to the south of the Senegal, and flows in nearly the same direction. It has a very extensive, wide, and rapid course, and discharges itself into the Atlantic in thirteen degrees of north latitude.

EUROPEAN RIVERS.

THE VOLGA.

In surveying the grand and beneficial assemblage of rivers dispersed over the countries of Europe, the Volga presents itself as the most extensive in its course, being above two thousand miles in length. Having passed through the territories of Russia, it enters Asia in 48 degrees 30 minutes north latitude, discharging its waters into the Caspian sea, by various channels, below Astracan, and producing many islands at the place where it disembogues.

The principal source of this great river issues from lake Ilmen, in the government of Novorogod, in about 58 degrees of north latitude: another considerable source is derived from a small lake to the south-east, in the government of Twer. These two streams unite at the capital of that name, near which the Volga first becomes navigable. Not only this river, but the Duna, the Nieper, and, indeed, all the principal rivers of European Russia, take their rise in the vast forest of Volkonski, which extends on the side of Smolensko almost to the gates of Moscow.

The banks of the Volga are in general fertile and well wooded, the greater part of the Russian oaks growing in the countries it waters. It is navigable for large ships; and toward the end of the spring is so swollen by the melting of the ice and snow, as to cause great inundations. This season is carefully watched by navigators, as they have at that time not only the opportunity of a safe passage over the shallows, but over several flat islands which lie at a considerable depth under water. This river receives several tributary streams, particularly the Occa and Cama, and abounds with that species of whale called beluga, from ten to eighteen feet in length.

THE DON.

This river, the Tanais of the ancients, has its source in the Iwano Ossero, or St. John's lake, near Tula. It runs first from north to south, and, after its confluence with the Sosna, directs its course from east to west, whence, taking several windings, it again runs from north to south, dividing at length into three channels, and falling into the sea of Asoph. In its course it approaches so near the Volga, that in one part, in forty-nine degrees of latitude, the distance does not exceed eighty miles. This led Peter the Great to form a design of uniting these two rivers by the means of a canal, and some progress was made in this enterprise, the completion of which was, however, abandoned on his death.

THE NIEPER.

This river the ancient Borysthenes, issues from a morass in the forest of Volconski, one hundred and twenty miles distant from Smolensko, and makes several windings

through Lithuania, Little Russia, the country of the Zaporo Cossacks, and a tract inhabited by the Nagaian Tartars. After forming a lake thirty-four miles in length, and in many places from two to six in breadth, it discharges itself into the Black Sea. Within the space of thirty-five miles, the Nieper, the banks of which are elevated, has not less than thirteen falls. At Kiow a floating bridge, one thousand six hundred and thirty-eight paces (upwards of a mile and a half) in length, has been thrown over it. This bridge is removed towards the end of September, to admit a passage down the river to the immense masses of floating ice; and is again put together in the spring. On this river a great number of mills have been erected in boats.

THE NEVA.

This river likewise belongs to the vast empire of Russia, and issues from the lake Lagoda, flowing with a rapid course until it discharges itself into the gulf of Finland. A great part of the city of St. Petersburgh is built on islands formed by its branches, and by those of the rivers Fontanca and Moica. It has but one bridge, which is constructed with large flat-bottomed boats, which are laid across the river in the spring, and removed in the autumn, at the setting in of the frost. In this way a safe and convenient passage is formed between the Arsenal and Basili Ostrow, or Bazil's island. The communication between the other islands is by boats and barks; but bridges are built over the Moica and Fontanca, and likewise over the canals, which are as numerous as at Amsterdam. St. Petersburgh is much exposed to inundations: in September 1777, one rose to a very great height, and did prodigious damage.

THE DWINA.

This is a very considerable river, the name of which implies *double*, it being formed by the confluence of the Sukona and the Yug. It divides itself into two branches, or channels, near Archangel, whence it runs into the White Sea.

THE DANUBE.

The next considerable river of Europe, in which quarter it rises and terminates, is the Danube, the ancient Ister. It has its source in Suabia, within a few miles of the borders of Switzerland, in latitude forty-eight degrees north, and nine degrees of east longitude, whence the Rhine also issues, but takes a north-west course, while that of the Danube is eastward. It intersects Bavaria, Austria, and Hungary, inclining to the south at Vaez, a town in the latter kingdom. It divides the bannat of Tamesvar from Servia, and Wallachia from Bulgaria, discharging itself, after a course of nearly fourteen hundred miles, by several channels, into the Euxine or Black Sea, with such violence, that its waters are distinguishable for several miles from those of the sea into which they are precipitated. It is said to receive sixty navigable rivers in its progress, and an equal number of smaller streams. From Buda, in the centre of Hungary, to Belgrade, on the northern confine of Servia, its depth and breadth are so considerable, that in the wars between the Christians and Turks, these powers had fleets on it, and several naval engagements took place. Farther down it is rendered unnavigable by its many cataracts, so that all commerce with the Black Sea, by means of this great river, is rendered impracticable.

THE RHINE.

Of all the countries of Europe, Switzerland is the one in which the greatest number of rivers take their rise. Of these the principal is the Rhine, which has its sources in the Grison territory; and by these the distinctions of Upper Rhine, Middle Rhine, and Lower Rhine, are determined. The Upper Rhine issues from a small lake on a mountain called the Oberalp. The Middle Rhine has its source in Luckmanier, one of the Adula chain of mountains, and joins the Upper Rhine, after a course of about eighteen miles. The Lower Rhine, rises at a distance of about nine miles, in a mountain, called by the Italians Monte del Uccelo, or Bird's Hill.

At a small distance from the lake of Constance, through which the Rhine flows, a bridge has been thrown over

it at Scaffhausen, which is much admired on account of the beauty and singularity of its architecture. The rapidity of the river having carried away several stone bridges, this one, constructed of wood, and of a single arch, has been so well contrived, as to be perfectly secure. Near this bridge is a fine water-fall.

Having flowed westward to Basle, it proceeds in a direction due north, along the eastern borders of Alsace, till it receives the Maine, a little below Frankfort, and proceeding thence north-westward, enters the Netherlands. Its course exceeds seven hundred miles; and on its banks the cities of Mentz, Coblentz, Cologne, Dusseldorf, Wesel, and Cleves, are situated. It intersects the circles of the Upper and Lower Rhine. In its course through Alsace it frequently causes dreadful devastations, not only in winter, but in the summer, when the snow melts on the Alps. Its inundations, in devastating the fields, cover them with sand; and the violence of its torrents, which are very frequent, occasionally change the situation of the islands placed within its bed.

One of the singularities of the Rhine is, that particles of gold are found in the sand which the torrents, in their fall, wash from the Alps, and bring into it. Hence it is only below Basle that the sand contains this precious metal, which, in autumn and winter, when the river is at the lowest, is drawn out with the sand, and extracted by repeated washings. Its particles are seldom so large as a grain of millet seed; but the gold is very fine and beautiful. It is so scarce, however, that the city of Strasburg, which has the privilege of collecting it for the extent of nearly four miles, scarcely collects five ounces in a year. This river also contains many crystals and particularly pebbles, which take a beautiful polish: these are well known under the name of Rhine pebbles.

At Utrecht the Rhine divides into two branches, called the Old and New Rhine, both of which cross the city throughout its length. One of these branches loses itself in the sands below Leyden, and the other, assuming the name of the Lech, falls into the Maine. Thus does this grand and important river, after so long and useful a course, terminate obscurely, without pouring its aggregated waters into the common receptacle, the ocean!

THE RHONE.

This fine river rises in the glacier of Furca, near the canton of Uri, in Switzerland, but in the north-east border of the Valais. It first precipitates itself with great noise from amid several rocks, and, in flowing into the vale beneath, has the appearance of a single cataract, with several cascades. It is afterwards joined by the Meyanwang stream, issuing from the Grimsel mountain, and then directs its course from east to west, until, after taking a winding course to the north, it discharges itself with great impetuosity into the lake of Geneva. All the streams and small rivers of the valais, issuing from the mountains, flow into it.

The waters of the Rhone rush into the lake with such rapidity, that for the distance of half a league they continue unmixed with those of the latter; but there is not afterwards any visible distinction, as has been affirmed. At its efflux from the lake it forms an island, on which, and on the banks on either side, the city of Geneva is built, being divided into three unequal parts, having a communication by four bridges. Onward it forms the boundary between France and Savoy. It then takes a western direction, and, dividing the province of Burgundy from that of Dauphine, flows to Lyons, from which city it proceeds due southward, forming the eastern boundary of Languedoc, which it divides from Provence at Avignon. It discharges its waters into the Mediterranean by several mouths, a little below Arles.

THE VISTULA.

This river is likewise called the Weisel, and in Polish the Wisla. It rises in the Carpathian mountains, on the confines of Silesia and Upper Hungary; and, taking a northwest course through Little Poland, a part of Masovia, of Great Poland, and of Prussia, falls by three mouths into the Baltic, below Dantsic. Warsaw, the capital of Poland, and Thorn, which once boasted a very considerable trade, are situated on its banks. Great quantities of grain and timber, the growth of Poland, are sent down this river to Dantzic, and thence exported to foreign countries.

THE ELBE.

Not far from the source of the above river, and in the principality of Javer, in Silesia, the Elbe rises in the Giants' Mountain. It divides Dresden, the capital of Saxony, into the old and new towns, between which there is a communication by a stone bridge, three thousand five hundred feet, (nearly three-fourths of a mile) in length, and in breadth eighty-five feet, provided with eighteen arches. Meissen, ten miles north-west of Dresden, is likewise situated on this river, over which is a bridge, supported by stone piers, but having a wooden superstructure: this bridge is considered as a master-piece of art, the middle arch, which is three hundred and seventy-five feet in width being kept together by a single wooden peg. The Elbe is the boundary of Brandenburgh toward the east, and there receives the Havel. It is the principle river in Lower Saxony. At Hamburgh it becomes of such a breadth and depth as to receive large ships. It discharges its waters into the German Ocean by the fortress of Glukstadt.

THE LOIRE.

Of the principal rivers which have their sources in France, the Loire is the most considerable, being still larger than the Rhone. It rises in the Cevennes mountains, in Lower Languedoc, and takes a course north and north-west, passing by the city of Orleans. It thence pursues a south and south-west course, by Tours and Angers, discharging itself into the bay of Biscay, forty miles below Nantz. Its entire course, comprehending its windings, is computed at five hundred miles; and in its progress it receives the Allier, Cher, Indre, Creuse, Sienne, and Maine. It communicates with the Seine by the canals of Briarte and Orleans. In November, 1790, it overflowed its banks, and laid a very large extent of country under water.

THE GARONNE.

This river rises at the foot of the Pyrenees, in the district of Cominges, and becomes navigable on the confines of Languedoc, being joined by many rivers in its course. It passes Toulouse and Bordeaux, below which it receives the

Dordogne, a river nearly of equal magnitude with itself. These united streams now take the name of the GIRONDE, become very broad, and empty themselves into the Bay of Biscay. By the means of this river, and a noble canal which will hereafter be described, a junction has been formed between the Mediterranean sea and the Atlantic.

THE SEINE.

THIS river rises near Dijon, in Burgundy, and, taking a north-west course, forms three islands on which the capital of France is situated. One of these, called l'Isle du Palais, communicates with the other parts of the city by seven bridges of stone, the principal of which is Pont-Neuf, provided with twelve arches, and having a breadth, including the parapets, of seventy-two feet. The Seine, in its passage through Normandy, flows by Rouen, and falls into the British Channel near Havre.

RIVERS OF SPAIN.

THIS kingdom abounds with rivers, the number of which, comprehending the smaller streams, is said to amount to one hundred and fifty. The principal of these are, the Minho, which rises in Gallicia; the Douro, which has its source in Old Castile, in a part of the mountains of Idubeda; and the Tagus, rising in a mountain of New Castile, through which province it passes, the city of Toledo being situated on its banks, and being encompassed by the river in the form of a horse shoe. It bounds the Portuguese province of Beira to the south, passes through that of Estremadura, and discharges itself into the Atlantic. Near the mouth of this river the Portuguese capital, Lisbon, is situated.

Indeed, all the great rivers which flow through Portugal, have their source in Spain. Thus the Gaudiana issues from New Castile, deriving its source from an assemblage of lakes, at a small distance from which it takes its course between several lofty mountains, concealing itself for nearly three miles, and then suddenly re-appearing in a fenny soil, but soon hiding itself again amidst reeds and rocks, which probably gave occasion to the mistaken idea of its losing itself under ground. This river separates the Spanish pro-

vince of Andalusia from the Portuguese province of Algarva.

The Guadalquivir, or Great River, by the ancients called Bætis, and Tartessus, rises in Andalusia, where several small streams, issuing from Mount Segura, unite in a lake from which this river flows. From Corduba to Seville, it is navigable by small craft only; but from the latter city to its mouth it receives ships of burthen, although it is dangerous on account of its many sand-banks.

The Ebro rises in the mountains of Santilane, in Old Castile, from two springs, and receives upwards of thirty brooks in its course, becoming navigable near Tudela. Its navigation is, however, dangerous on account of the rocks and shoals with which it abounds. It at length discharges itself into the Mediterranean, forming at its mouth the small island of Alfacs.

In the province of Andalusia, the river Tinto, or Azeche, presents a singular phenomenon. Not only are its waters of so bad a quality as not to be potable, but it is asserted that they are noxious even to plants and to the roots of trees. It is consequently not the abode of fishes, or of any of those reptiles which breed in the aqueous element.

ITALIAN RIVERS.

Among the principal rivers of Italy, the following are the most worthy to be cited. The Po, which rises in Mount Viso, in Piedmont, one of the highest of the Alps, discharges itself into the Adriatic by seven mouths. It passes through Monserrat, the Milanese, and the Mantua, and washes the borders of the Parmesan territory, and a portion of the Milanese. It frequently overflows its banks, and causes great devastations.—The Adige has its source in the Rhætian Alps, and waters the cities of Trent and Verona: it is the only large river in Lombardy, and does not unite with the Po, but, like that river, flows into the Adriatic.—The Arno flows from the Appenine mountains, and falls into the Tuscan sea near Pisa.—The Tiber, which issues from the Apennine mountains, at an inconsiderable distance from Rome, empties itself also into the sea of Tuscany. Its waters are generally so foul and muddy at Rome, that horses are not watered at its stream; but after reposing a few days

they become clear and fit to drink. The bed of this river being raised by the ruins of many edifices which have fallen into it, and its mouth much choked up, it frequently overflows its banks, more particularly during the prevalence of a strong south wind.

BRITISH RIVERS.

The principal rivers of England are the Thames, the Severn, the Trent, and the Humber.

THE THAMES.

Thames, the most lov'd of all the Ocean's sons
By his old sire, to his embraces runs;
Hasting to pay his tribute to the sea,
Like mortal life to meet eternity.
Nor are his blessings to his banks confin'd,
But free and common as the sea or wind;
Where he, to boast or to disperse his stores,
Full of the tribute of his grateful shores,
Visits the world, and in his flying tow'rs
Brings home to us, and makes both Indies ours;
So that to us no thing, no place is strange,
While his fair bosom is the world's exchange.
O could I flow like thee, and make thy stream
My great example, as it is my theme!
Though deep, yet clear; though gentle, yet not dull;
Strong without rage, without o'erflowing full.

DENHAM.

This fine river, if considered respectively to its course and navigation, is not to be equalled by any one in the known world. It rises from a small spring somewhat to the south-west of Cirencester, in Gloucestershire; and, taking an eastward course, becomes navigable at Lechlade for vessels of fifty tons. It there receives the river Colne, at a distance of about one hundred and thirty-eight miles from London. From Lechlade it continues its course north-east to Oxford, where it receives the Charwell; after which it runs south-west to Abingdon, and thence to Dorchester, where it receives the Thame, and continuing its course south-east, flows by the borders of Berkshire, Buckinghamshire, Surrey, Middlesex, Essex, and Kent. In this extensive progress it passes along a multitude of towns and

fine picturesque villages; and, having visited London and Westminster, proceeds by Deptford, Greenwich, Woolwich, and Gravesend, to the sea.

To represent the beauties with which the banks of this noble river are embellished, between Windsor and London, would require the pencil of a Claude, or the pen of the sublimest of poets: besides numerous villages, they are adorned with magnificent seats and gardens, belonging to the nobility and gentry. The tide flows as high as Richmond, in Surrey—a distance which, following the winding course of the river may be computed at seventy miles from the sea. At London the depth of water is sufficient for the navigation of large ships, which renders it the greatest port for trade in the commercial world. Its water is justly esteemed exceedingly wholesome, and fit for use in the longest voyages, during which it ferments, and becomes fine and clear. The Thames, likewise, abounds with a great variety of fishes.

THE SEVERN.

THIS river springs from a small lake on the mountain of Plynlimmon, in Montgomeryshire, and is the principal beauty of that part of Wales, in which it receives so many small streams, that it becomes navigable near the town of Montgomery. It passes through the centre of Shropshire, the towns of Shrewsbury and Bridgenorth being situated on its banks; and thence directs its course from north to south, through Worcestershire, taking the city of Worcester, and the town of Tewkesbury, in its route. Entering Gloucestershire, it runs by the city of Gloucester, and discharges itself into a large bay, called the Bristol channel, from the commercial city in its vicinity. About fifteen miles from its mouth, a navigable canal has been constructed, which conveys the waters of this river to within about two miles of Cirencester: they are then carried by a tunnel, or archway, fifteen feet in height above the surface of the water, through Saperton hill, an extent of two miles and three furlongs, for the purpose of communicating with the Thames at Lechlade. The Severn is distinguished by the abundance of salmon which frequent it, and by the lamprey, a fish almost peculiar to this river.

THE TRENT.

This river rises among the moor-lands in the north-west part of Staffordshire, and having received the tribute of several rivulets and streams, runs to the eastward. It becomes navigable at Burton-upon-Trent, where it leaves that shire, and flowing through Derbyshire, Nottinghamshire, and Lincolnshire, discharges itself into that great receptacle of the northern rivers, the Humber, after a course of nearly two hundred miles. It enters Nottinghamshire at the south-west point, and being there joined by the Erwash, passes to the eastward till it reaches Newark, where it forms an island; when turning to the north, after a tract of about fourteen miles, it constitutes the boundary of that shire on the side of Lincolnshire.

The Trent is joined a little below Burton by the beautiful river Dove, which rising at the most northern point of Staffordshire, forms the boundary between it and Derbyshire, and joins the Trent a little below Burton. Another river, the Sow, rises a few miles to the west of Newcastle-under-line, and falls into the Trent on the south-east. A canal has been formed from Chesterfield, in Derbyshire, which passing through the northern part of Nottinghamshire, communicates with the Trent at a little distance below Gainsborough. In its course a subterraneous tunnel has been cut through Norwood hill, upwards of a mile and a half in extent, and so straight, that the termination at one end may be seen at the other. The arch is twelve feet high, nine feet three inches in width, and in the deepest part one hundred and eighty feet beneath the surface of the earth. By the numerous canals formed in the north of England, a communication is now opened between the Trent and the Mersey, or quite across the kingdom, from east to west.

THE HUMBER.

The rivers which fall into the Humber are the Ouse, or Northern Ouse, and those by which the Ouse itself is enriched, as the Dun, or Don, the Derwent, the Calder, the Aire, the Wharse, the Nidd, the Yore, and the Swale. The Ouse rises in the west-north-west side of Yorkshire,

and chiefly runs to the south-east. The Dun, or Don, rises in the hills near the south-west extremity of Yorkshire, where it is called the Sheaf, and running to the southward until it reaches Sheffield, turns to the north-east and falls into the Ouse. The Calder has its source in the border of Lancashire, and entering the south-west side of Yorkshire, runs eastward, and joins the river Aire. The Aire springs from the foot of a hill, called the Pennigent, and with a slow course, chiefly to the eastward, discharges itself into the Ouse. The Wharse or Wherse, rises among the hills in the west of Yorkshire, and flows with a swift and impetuous current, chiefly to the south-east, till it falls into the Ouse. The Swale rises among the north-west hills of Yorkshire, and, running to the south-east, joins the Nidd about four miles below Boroughbridge. The Derwent, which divides the North and East Ridings, rises in the north-east part of Yorkshire, near the sea-coast, between Whitby and Scarborough, and first running to the south, winds to the west, and again to the south, falling at length into the Ouse. The river Hull has its source in the Woulds, whence it runs chiefly to the southward, passing near Beverley, and falls into the Humber. Into each of these rivers a great number of rivulets discharge themselves.

The Humber is formed at the confluence of the Ouse, and may rather be considered as a narrow bay than a river, being throughout its short course of an extreme width. Its whole extent to Spurnhead, a narrow peninsula which terminates Yorkshire to the south-east, does not exceed thirty-six miles. By one of the rivers which flow into it, Yorkshire partakes, however, of the advantages derived from the great modern improvement, canals. A communication has been made between the western and eastern coasts, across Lancashire and Yorkshire, by a canal which proceeds from the river Mersey, at Liverpool, to the Ouse, at Selby, sixteen miles above its junction with the Humber. It crosses the county of York, from Holme-bridge, four miles north-west of Skipton, to the Ouse, passing by Leeds; and has two subordinate branches, one leading to Bradford, and another to the vicinity of Wakefield, to facilitate the communication between that place and Halifax.

THE FORTH.

THIS river, the most considerable in Scotland, has its origin from a lake under Ben Lomond, in the western angle of Sterlingshire, and runs eastward to Stirling, near which place it unites with the Teith, and forms Lake Katherine. From Stirling it flows west by south, and mixes with the German Ocean by a wide estuary, called the Firth of Forth. From its origin to Berwick, at the mouth of the Firth, its course, exclusive of windings, is seventy-five miles. It is navigable as far as Stirling for vessels of eighty tons burthen. Its winding stream, skirted by woods, by fertile and well-cultivated plains, and occasional ancient ruins; its waters, at times spreading themselves from a small breadth to the expanse of a lake; and the Lennox and Oichill hills rising from its northern bank, afford many pleasing and delightful prospects. A canal now joins this river to the Clyde.

THE TAY.

THIS river, springing from Benmore, on the western borders of Perthshire, runs north-east to a lake of the same name, one of the most beautiful in Scotland, at the extremity of which, being joined by the Lyon, it continues the same course to Logierait, where it receives the waters discharged by the Tumel river, from the lakes Ericht, under Ben Alar, the Rannoch, and the Tumel. From Logierait it flows south by east between Great and Little Dunkeld, and bends eastward, curving again to Cargil: near Cargil it receives the Isla from Forfar, and turns southward to Perth, receiving the river Earn from a lake of a similar name westward. It empties itself, by an estuary called the Firth of Tay, into the German Ocean. This river is navigable for vessels of burthen above Perth: the length of its course is nearly a hundred miles.

THE SHANNON.

AMONG the many navigable rivers of Ireland, the noble river Shannon asserts its preeminence. If the extent of its course, the richness and fertility of the fine country it waters, its great subserviency to commerce, and the excellent bay at its mouth, be considered, it may fairly rank among the most eminent rivers of Europe. It has its origin in

Lough or Lake Nean, eleven miles east-south-east of Sligo, the chief town of the county of that name, in the province of Connaught; whence, passing under Ballyntrane bridge, after a south-south-east course of five miles, it falls into Lough Allen. To Carrack, traversing this lake latitudinally, its course, for eight miles, is nearly south.—There it receives a stream which brings it from the right the superfluity of the waters of Lough Gara, and Lough Key; and after a winding course in a south-east direction, it flows into Lough Boffin, ten miles from Carrick. From the south-eastern extremity of the lake it takes a south-west direction, its current being now much broader, to Lough Ree, which it joins at Langsborough, and leaves at Athlone, seventeen miles south-south-east of its entrance into the lake. Thence bending to the west it receives the Suck from the right at Raghery nearly seventeen miles south-south-west of Athlone; and five miles beyond this point, the Brosna, from the left at Banagher, south-south-west of Raghery. From Banagher it makes a long course towards the west, and fourteen miles south-west of that place joins Lough Derg, which at Ballaloe, twenty-two miles south-south-west of its entrance into the Lough, it quits, pursuing the same course to Limerick, eleven miles distant, whence its direction is west by south to the sea. Between Limerick and the sea it receives several small rivers from the county of Clare; and the Maig, with others of inferior size, from the county of Limerick, on the left; and at its mouth the Cushion from Kerry. The mouth of this beautiful river is free from any bar, and forms a capacious bay eleven miles long, and from six to eight in breadth, exempt from every species of danger, and from any strong current; but, unfortunately, much exposed to western gales: some few sunken rocks, also, between Achnish Isle and Limerick, require a pilot's skill to avoid. This river is navigable from its mouth to Limerick for vessels of large burthen, and for vessels of inferior draught as far as Ballyntrane-bridge, at the extremity of Lough Allen, a hundred and eighty miles from abreast of Kerry Head. From Limerick, to avoid the rocks and shallows at the bend, a canal is cut seven miles in length; and the Grand Canal from Dublin, joining this river at Banagher, a communication is formed between the Shannon and the Irish sea.

LAKES.

AMERICAN LAKES.

The northern parts of this division of the globe are distinguished by their numerous and immense lakes, the five principal of which lie either wholly, or chiefly, in the two Canadian provinces: these are the lakes Superior, Huron, Ontario, Erie, and Michigan. These vast assemblages of fresh water, which are neither put in motion, nor alternately raised and sunk, by tides, are supposed to contribute very considerably to the greater degree of cold felt in the northern parts of America, than in the same parallels of latitude in Europe. They are situated within about seven degrees of latitude, and fourteen of longitude, or from 41° 35′ to 49° north, and from 75° 20′ to 92° west.

LAKE SUPERIOR.

This great North American Lake is justly entitled to the distinguished name it bears, not only because it is the largest expanse of fresh water in the known world, surpassing in magnitude the Asiatic salt-water lake improperly denominated "the Caspian sea," but because it has a much greater elevation than the other lakes of that country, the level of its waters being several hundred feet higher than the river St. Laurence. Its circumference is estimated at about fifteen hundred miles; but it has been observed by an intelligent navigator, Carver, that "if it were coasted round, and the utmost extent of each of the bays taken, it would exceed sixteen hundred!" He coasted nearly twelve hundred miles on the north and eastern shores. "When it was calm," he observes, "and the sun shone bright, I could sit in my canoe, where the depth was upwards of six fathoms, and could plainly see huge piles of stones at the bottom. The water at this time was pure and transparent as the air, and my canoe seemed as if it hung suspended in that element. It was impossible to look attentively, through this limpid medium, at the rocks beneath, for even a few minutes without feeling the

head swim, and the eyes no longer able to view the dazzling scene. This occurred in the month of July; and, although the surface of the water, from the heat of the atmosphere, was warm, still on letting down to the depth of about a fathom, the water drawn thence was so excessively cold, that it had nearly the same effect as ice, when taken into the mouth.

Lake Superior is said to receive nearly forty rivers and streams of water; the two principal rivers are the Alanipegon, from the north, and the Michipicooton, from the west. By the means of the latter a communication is established with the lakes of Bourbon, Winnipeek, and du Bois; and in this river the source of the St. Laurence is said to have been traced. A small river on the west, before it enters the lake, has a perpendicular fall from the top of a mountain, of more than six hundred feet, through a very narrow channel. In this lake, which has one passage only, St. Mary's strait, for the discharge of its waters, there are many islands, two of which are of great extent. The largest of them, Isle Royal, is nearly a hundred miles from east to west, and about forty miles from north to south. Miropau Isle is likewise of considerable extent; and at the entrance of West Bay is a cluster of small islands, called, "The twelve Apostles." On the south side of the lake is a peninsula, which spreads into the lake sixty miles.

LAKE HURON.

THIS lake is next in magnitude to the one described above, being about a thousand miles in circumference. Its shape is nearly triangular; and on its north side is an island nearly an hundred miles in extent from east to west, and about eight from north to south: it is called by the Indians *Manataulin*, which signifies the abode of spirits. At the west point of the lake are the straits of *Michillimackinac*, which unite with lake Michigan; and about fifty miles to the north-east of these straits are those of St. Mary, by which lake Huron communicates with lake Superior.—They are about forty miles in length, and have falls, which are not, however, perpendicular, like those of Niagara, but the waters of which pass along a sloping bottom, and are on that account named THE RAPIDS. These are about three

quarters of a mile in length, but not so impetuous as entirely to obstruct the navigation downward. The southern point of lake Huron runs into a strait, which soon after enlarges into a small lake called St. Claire, from which runs another strait named Detroit. The latter discharges itself into lake Erie, the distance between which and lake Huron is eighty miles.

Lake Erie extends about three hundred miles from west to north-east, and in its widest part is about seventy miles in breadth from north to south. Its navigation is more dangerous than that of the other lakes, on account of many high lands on its borders projecting into the waters, insomuch that, when sudden storms arise, canoes and boats are frequently lost, there not being any place to afford shelter or retreat. Several islands near its western extremity are so infested by venomous snakes, that it is highly dangerous to land on them. It discharges its waters, at the north-east extremity, into lake Niagara.

Lake Michigan, to the west of lake Huron, is long and narrow, extending nearly two hundred miles from north-west to south-east, and having a breadth of forty miles from north to south. Between these two lakes a peninsula is formed, which runs to a point at the north-west; and on the same side is a straight about forty miles wide, called the Grand Traverse, within which are several islands inhabited by Indians. This strait leads to a long and narrow bay, called Green Bay, into which flows the Fox River, rising near the Mississippi, and having its banks inhabited by a powerful tribe of Indians.

Lake Ontario is the smallest of the five great Canadian lakes. Its form is nearly oval, its greatest length being from north-east to south-west, and its circumference about six hundred miles. Near to the south-east part it receives the waters of the Oswego river, and on the north-east discharges itself into the river Cataraqui, communicating with the river St. Laurence.

To the eastward of these great lakes, are lakes George and Champlain. The most northern lake visited by the traders, is lake Bourbon, extending to 51° north latitude; and to the south of this is lake Winnepeek communicating with the former by a strait. From this lake a river extends to lake Superior.

In the southern part of the American continent, lake Mayacaybo is the only one deserving a particular notice. It communicates with the gulf of Venezuela, by a strait, on the western coast of which the city of Mayacaybo is situated. This lake is eighty leagues in circumference, and contributes equally to the beauty and convenience of the province of Venezuela, with which it is encompassed.— The gulf of this lake, which terminates in the Caribbean sea, extends about a hundred and ten miles from south to north.

ASIATIC LAKES.

LAKE ASPHALTITES.

This Lake is more usually known by the name of the Dead Sea. It lies in Palestine, and is about fifty miles in length, and twelve or thirteen in breadth. It is surrounded by lofty mountains, and receives the river Jordan. It covers the ground on which stood the cities of Sodom and Gomorrah, buried, according to Strabo's report, by an earthquake, accompanied by frequent eruptions of fire, or, according to the scriptural expression, by a rain of sulphur. This lake is rendered remarkable by the great quantity of the bituminous and inflammable substance, called Asphaltos, floating on its surface. This substance, having been thrown up from the bottom in a melted state, by the agency of subterraneous heat, and having become solid by the coldness of the water, is collected on the margin of the lake.

Doctor Clarke, in his recent travels, has removed the superstitious prejudices so long entertained relative to the Dead Sea, of which he gives the following animated description.

"The Dead Sea below, upon our left, appeared so near to us, that we thought we could ride thither in a very short space of time. Still nearer stood a mountain upon its western shore, resembling in its form, the cone of Vesuvius, and having also a crater upon its top, which was plainly discernible. The distance, however, is much greater than it appears to be; the magnitude of the objects beheld in this fine prospect, causing them to appear less remote than

they really are. The atmosphere was remarkably clear and serene; but we saw none of those clouds of smoke, which, by some writers, are said to exhale from the surface of Lake Asphaltites, nor from any neighbouring mountain. Every thing about it was, in the highest degree, grand and awful. Its desolate, although majestic, features, are well suited to the tales related concerning it by the inhabitants of the country, who all speak of it with terror, seeming to shrink from the narrative of its deceitful allurements and deadly influence. 'Beautiful fruit,' say they, 'grows upon its shores, which is no sooner touched, than it becomes dust and bitter ashes.' In addition to its physical horrors, the region round is said to be more perilous, owing to the ferocious tribes wandering upon the shores of the lake, than any other part of the Holy Land. A passion for the marvellous has thus affixed, for ages, false characteristics to the sublimest associations of natural scenery in the whole world: for although it be now known that the waters of this lake, instead of proving destructive of animal life, swarm with myriads of fishes; that instead of falling victims to its exhalations, certain birds make it their peculiar resort; that shells abound upon its shores; that the pretended 'fruit, containing ashes,' is as natural and as admirable a production of nature, as the rest of the vegetable kingdom; that bodies sink or float in it, according to the proportion of their gravity to the gravity of the water; that its vapours are not more insalubrious than those of any other lake; that innumerable Arabs people the neighbouring district; notwithstanding all these facts are now well established, even the latest authors by whom it is mentioned and one among the number, from whose writings some of these truths have been derived, continue to fill their descriptions with imaginary horrors and ideal phantoms, which though less substantial than the 'black perpendicular rocks,' around it, 'cast their lengthened shadows over the waters of the Dead Sea.' The ancients, as it is observed by the traveller now alluded to, were much better acquainted with it than are the moderns; and, it may be added the time is near at hand, when it will be more philosophically examined. The present age is not that in which countries so situated, can long continue unexplored. The thirst of knowledge, and the love of travel, have at-

tained to such a pitch, that every portion of the globe will be ransacked for their gratification."

THE CASPIAN SEA.

This large body of water, improperly called a sea, as it neither ebbs nor flows, nor has any visible connexion with the ocean, is the greatest lake in the eastern hemisphere. It is bounded on the north by the country of the Calmuc Tartars, on the east by Bucharia and a part of Persia, on the south by another part of Persia, and on the west by Persia and Circassia. Its length, from north to south, is about four hundred miles, and its greatest breadth, from east to west, three hundred. Within the last fifty years the water has risen so considerably, that it has made great inroads on the Russian side, both to the east and west of the Volga, and has rendered the adjacent country extremely marshy.

AFRICAN LAKES.

The only lake deserving of notice in this arid and sandy quarter of the globe, is that of Dambia, in Upper Ethiopia. In describing the Nile, it has already been mentioned that it is considered as the source of that interesting river. This lake contains twenty-one islands, several of which are very fertile, more particularly the largest, called Tzana, the name likewise bestowed by the natives on the lake itself. Its greatest extent, in a north-east and south-west direction, is about ninety miles, and its breadth thirty-six.

EUROPEAN LAKES.

These Lakes, although much inferior in size to several of those above described, merit a brief description on account of the phenomena they occasionally present.

Lake Lagoda, in the western part of the Russian empire, lies between the gulf of Finland and lake Onega, and is one hundred and fifty miles in length, and ninety in breadth. It is the largest lake in Europe; but is so full of quicksands, which are constantly moved from place to place, by the frequent storms to which it is subject, that very dangerous shelves are formed along its course. This led Peter the Great to cause a canal, nearly seventy English miles in length, seventy feet in breadth, and about eleven feet in

depth, to be cut at a vast expense, from the south-west extremity of the lake to the sea. The completion of this canal, which has twenty-five sluices, or locks, and into which several rivers flow, was a labour of fourteen years. To keep it in repair is the constant employment of a regiment of soldiers, who for that purpose are stationed on different parts of its banks. LAKE ONEGA is situated between this lake and the White Sea, and communicates with the former by the river SWIR. It is one hundred and twenty miles in length, and in breadth between fifty and sixty. Notwithstanding its waters are fresh, it is frequented by seals.

The other principal Lakes of the north of Europe are the following. LAKE PEIPUS, in Livonia, nearly seventy miles in length, and forty in breadth, runs into the gulf of Finland by the river Narva, and is celebrated for the abundance of fishes with which it swarms.—In Sweden Proper, which abounds with lakes, the most considerable is LAKE MALER, situated between Upland, Sudermanland, and Westmanland. It is seventy two miles in length, and is said to contain not less than twelve hundred and ninety islands. It communicates with the sea by the mouths of the north and south rivers, which enter it near Stockholm, and its banks are in every part beautifully diversified.—LAKE WETTER is the most remarkable of the twenty-three lakes to be found in East Gothland. It is ninety miles in length, fifteen in breadth, and has but one outlet, by the river Motala, although it receives upwards of forty small streams. This lake lies a hundred feet higher than either the Baltic or the North Sea, and is deep and clear, but very boisterous in the winter season. On its banks are found agates, cornelians, and other precious stones.

THE LAKE of CONSTANCE is one of the great boundaries which separate Switzerland from Germany. Its broadest part stretches into Switzerland; while towards Germany it divides itself into two arms, one called THE ZELLERSEE, or Lake of Zell, and the other the Bodmen, or Lake of Uberlingen. In the former is the island of Reichenau, three miles in length, and one in breadth, abounding with fine vineyards, and all kinds of fruit; and in the latter, the small island of Meinau. From Bregents to Zell this lake is likewise distinguished by two appellations, the part

from the former of these places to Constance being called the Upper Lake, and that from Constance to Zell the Lower Lake.

The Lake of Geneva resembles the sea, both in the colour of its water, the storms which are raised on it, and the ravages it makes on its banks. It receives different names from the coasts it washes, and has in summer something like the flowing and ebbing of the tide, occasioned by the melting of the snows, which fall more copiously into it at noon than at other times of the day. It it is shaped like a half moon, its convex side looking towards Switzerland; having on that side a length of forty-eight miles, while towards Savoy its length does not exceed thirty-six. It is of such a depth as to be navigable for larger vessels than are commonly seen in rivers. Near Villeneuve, the Rhone discharges itself into it with such rapidity, that for the distance of half a league, the river water, which is very foul, continues unmixed with that of the lake, which is particularly clear.

Lago Maggiore, in the Duchy of Milan, is a most extraordinary lake, sixty miles in length, and six in its general breadth, with a depth of eight fathoms in the centre. It is surrounded on every side with hills covered with vineyards; and along its banks are rows of fine trees, and walls arched with vine branches. This enchanting prospect is heightened by several large natural cascades falling from the mountains. At the part where it widens into a bay, appear the two celebrated islands named Isola Bella, and Isola Madre, which have been compared to two pyramids of confectionary, adorned with green festoons and flowers. At one extremity of the garden of Isola Bella, are ten terraces, the perpendicular height of which, taken collectively, is more than two hundred feet above the level of the water of the lake. These terraces decrease proportionably in their circuit as they rise toward the top of the hill, where an oblong area, paved with fine stone, and surrounded with a ballustrade, affords a most delightful prospect. Isola Madre has seven terraces, which are high, but sloping, and at a considerable distance from each other, on which account it appears to be lower than Isola Bella, although the terraces have been planned of an equal height. Nature was, perhaps, never so successfully aided by the

decorations of art, as in the disposition of the gardens and ornaments with which these islands, so beautiful in themselves, are embellished.

BRITISH LAKES.

ALTHOUGH these Lakes are far inferior in size to those described above, they are not without their sublimities, and present pheuomena which deservedly class them among the wonders of nature.

The most interesting of these is Ulswater, a lake of Westmoreland, ten miles north of Ambleside, and fourteen south-west of Penrith. It is nine miles in length, and nearly a mile in breadth. On this lake much amusement arises from the discharge of guns, or small cannon, at different stations. The report is reverberated from rock to rock, promontory, cavern, and hill, with every variety of sound; now dying away on the ear, and again returning like peals of thunder. It is thus re-echoed seven times distinctly. The lake, viewed from an ascent, flows majestically in its calmness, clear and smooth as a blue mirror, with winding shores and low points of land, covered with green inclosures. The water is almost every where bordered with cultivated lands, gently sloping upward from a mile to a quarter of a mile in breadth, till they reach the feet of the mountains, which rise, rudely and awfully, on either hand, displaying their broken summits. Directly in front, at a distance of somewhat more than three miles, Place-Fell, one of the loftiest of these mountains, pushes its bold broad breast into the middle of the lake, and forces it to alter its course, forming first a large bay to the left, and then bending to the right. From a south-west direction it flows due west, but is soon interrupted again by the root of Hevellyn, a lofty and very rugged mountain; when, once more spreading its waters, it turns off to the south-east, and is lost among the deep recesses of the hills.

Winander-Mere, the longest and most beautiful lake in England, said to be so called by the Saxons on account of its winding banks, lies, among mountains where eagles build their nests, in the western part of Westmoreland, and on the borders of Lancashire. It is about ten miles in length, from north to south, but its breadth does not any

where exceed a mile. It is in some parts of a vast depth; and its bottom is one continued rock, with which it is in a manner paved.

The Lake of Derwent Water, three miles in length, and half a mile in width, lies in the beautiful vale of Keswick. Out of this lake rise five islands, which being covered either with turf or trees, add greatly to the beauty of its most picturesque appearance. Still more to the north-west, the river Derwent, after running for a short space in a narrow channel, spreads itself into a long and narrow lake, called Bassenthwaite, at the termination of which is a remarkable water-fall named Lowdore.

Loch Lomond is the most beautiful of the lakes of Scotland, it is thirty miles in length, and its greatest breadth ten miles. Its greatest depth, which is between Firkin point and Ben Lomond, is a hundred and twenty fathoms. The first view of this charming lake, from an elevated spot near Torbat, presents an extensive serpentine winding amid lofty hills, which, towards the north, are barren, black, and rocky, darkening with their shade that contracted part of the water. On the west side, the mountains, the summits of which are lofty, naked, and craggy, are clothed beneath with woods of oak quite to the water's edge. Toward the east the mountains are equally high, but their summits form a more even ridge, parallel to the lake, except when Ben Lomond, like Saul amidst his companions, overtops the rest. And, lasty, the eastern boundary is formed of a part of the Grampian hills.

The first scene which presents itself to the view of the admiring spectator, is separated from one totally different, by two headlands covered with trees, the most remote of which is Firkin point. On passing this cape an expanse of water bursts at once on the view, varied with all the softer beauties of nature. Immediately beneath is a flat covered with wood and corn: beyond, the headlands stretch far into the water, and consist of gentle risings; many having their surfaces covered with wood, while others are adorned with trees loosely scattered over a fine verdure, or over the purple bloom of the heath. Numbers of islands are dispersed over the lake; some of the same elevated form as the little capes, and wooded in the same manner; others

just peep above the surface, and are tufted with trees; and several are so disposed as to form magnificent vistaes between.

The other remarkable lochs, or lakes, of Scotland, are Loch-Tay, Loch-ness, and Loch-Leven, whence arise rivers bearing the same name; and Loch-Jern, from which flows the river Jern. Of these the one most deserving of a concise description is Loch-Ness, which is twenty-four miles in length, and in most parts two in breadth.—This lake has been sounded in many parts, with upwards of five hundred fathoms of line, without any bottom having been found. Its banks are mountainous, and covered with wood. That its waters never freeze, is ascribed to the many great springs which flow into it. It discharges itself into the river of the same name, six miles in length, which likewise never freezes, but has a condensed evaporation during the frost. Near to this lake is the great mountain Meal-fuor-vonny, of a round shape, on the summit of which is a lake of fresh water, about thirty fathoms in length, and six in breadth, without any course or stream running to or from it. Although of so inconsiderable an extent, it is unfathomable.

Ireland abounds more in Lakes than perhaps any other country of the same extent, more especially in the provinces of Ulster and Connaught. They are usually classed under two denominations; fresh water lakes, which have no access of tide, or mixture with the sea; and salt lakes into which the tide flows, and which may more properly be called inlets of the sea.

The most extraordinary fresh-water lake is Lough-Lean, otherwise called the Lake of Killarney, in the county of Kerry. It possesses singular beauties, and is divided into three parts. The northern, or lower lake, is six miles in length, and from three to four in breadth. On the side of one of the mountains is O'Sullivan's cascade, which falls into the lake with a roaring noise which strikes the timid spectator with awe. The view of this sheet of water is uncommonly fine, appearing as if it were descending from an arch of wood, which overhangs it above seventy feet in height from the point of view. The islands are not so numerous in this part as in the Upper Lake; but there is one of uncommon beauty, called Innisfallen,



No. 44.—Falls of Niagara.

Londonderry, Antrim, and Down; the latter of which it touches by a small point on the south-east side. It receives six considerable rivers, four of smaller note, and several brooks; notwithstanding which, it has but one outlet for the discharge of this great flux of waters.—Among its peculiarities, it has that of petrifying vegetable substances.

LOUGH-ERNE is divided into two branches, the Upper and Lower, which are thus formed by the water being contracted into the compass of a considerable river for several miles, after which, having spread, it forms the lower lake. In both its branches, it takes its source through the whole length of the county of Fermannagh, from the south-east point to the north-west, nearly dividing it into two equal parts. It abounds with a great variety of fishes, among which are pike of a prodigious size.

CATARACTS AND CASCADES.

FALLS OF NIAGARA.

[*See Plates, No.* 44, 45.]

THE river Niagara, in Upper Canada, takes its rise in the eastern extremity of Lake Erie, and, after flowing for twelve leagues, empties itself into Lake Ontario. Its breadth is nine hundred feet, and its depth very considerable; but its current is so exceedingly strong and irregular, and its channel so frequently interspersed with rocks, that it is navigable for small boats only. Proceeding lower, the stream widens, and the rocks gradually recede from the view, and the current though strong, is smooth and regular. At fort Chippeway, however, situated one league above the cataracts, the scene is again changed, and the river so agitated, that a boat would be inevitably dashed in pieces, were it permitted to pass Fort Niagara, situated on its bank. So impetuously do the waves break among the rocks, that the mere sight of them, from the adjacent shore, is sufficient to strike terror in the spectator. As it approaches the falls, the stream rushes along, with redoubled fury, until it reaches the edge of the stupendous precipice, when it tumbles suddenly to the bottom, without meeting with any obstruction in its descent. Precisely at this place, the river strikes off to the

right, and the line of cataracts winds obliquely across, instead of extending, in the shortest direction, from the one bank to the other. It ought to be observed, that the water does not precipitate itself down the vast abyss in one entire sheet, but, being separated by islands, forms three distinct collateral falls.

One of these is called THE GREAT, or HORSE-SHOE FALL, from the similarity of its form to that of a horse-shoe. It is situated on the north-west extremity of the river, and is most deserving of the attention of the spectator, as its grandeur is evidently superior to that of the adjacent cataracts, although its height may be considerably less. As the extent of this fall can be ascertained by the eye only, it is impossible precisely to describe its limits; but its circumference is generally computed at one thousand eight hundred feet, somewhat more than one third of a mile. Beyond the intervening island, the width of which may be equal to one thousand and fifty feet, is THE SECOND FALL, about fifteen feet wide; and at the distance of ninety feet, occupied by the second island, is situated Fort Scloper fall, so called from its proximity to that fort. The dimensions of this cataract may be reckoned equal to those of the large island; so that the entire extent of the precipice, including the intermediate islands, is four thousand and five feet; a computation which certainly does not exceed the truth. The quantity of water precipitated from the falls is prodigious; and agreeably to a late estimate, amounts to *six hundred and seventy thousand, two hundred and fifty tons per minute.*

From the eminence entitled "the Table Rock," the spectator has a fine prospect of the terrific RAPIDS, above the falls, and of the surrounding shores, embellished with lofty woods. He there sees to advantage the adjacent HORSE-SHOE FALL, and the dread abyss, into which he may look perpendicularly from the edge of the rock, if his courage be equal to his curiosity. The immensity of the various objects which here present themselves to the view, infallibly overwhelms a stranger with astonishment, and several minutes must elapse before he can possibly collect himself sufficiently to form any just conception of the awful and magnificent scene before him, which requires, that all its component parts should be separately examined, and

which affords so truly surprising an exhibition, that persons who have resided in its vicinity for several years, and who have been constantly habituated to its sublimity, ingenuously acknowledge, *at their last visit*, that they were never able before to discover its peculiar grandeur.

From a cliff nearly opposite to one extremity of FORT SCLOPER CATARACT, the falls are seen in a very interesting point of view: the scenery there, it is true, is less magnificent, but is infinitely more beautiful than from any other station. For several miles beneath the precipice the river is bounded, on either side, by steep and lofty cliffs, composed of earth and rocks, which in most parts are perpendicular. The descent to the bottom of the falls is here accomplished by two ladders, formed of long pine trees, with notches on their sides, on which the traveller rests his feet, and passes down amidst a variety of huge misshapen rocks and pendant trees, which seem to threaten him with instantaneous destruction. The breadth of the river in this part is about two furlongs; and towards the right, on the opposite side, FORT SCLOPER FALL appears in a very advantageous point of view. About one half of the HORSE-SHOE FALL is concealed by the projecting cliff, but its partial prospect is extremely fine. The bottom of the former of these falls is skirted with a beautiful white foam, which ascends from the rock in thick volumes, but does not rise into the air like a cloud of smoke, as is the case with that of the latter fall, although its spray is so considerable, as to descend like a shower of rain, near the second ladder, on the opposite side of the river. On its brink, and along the strand, to the GREAT FALL, are to be constantly seen shattered trees and bodies of animals, which have been carried away by the extreme violence of the current.

The colour of the water of the cataracts, as it descends perpendicularly on the rocks, is occasionly a dark green, and sometimes a foaming brilliant white, displaying a thousand elegant variations, according to the state of the atmosphere, the height of the sun, or the force of the wind. A portion of the spray, resulting from the falls, frequently towers above the height, and literally mingles with the clouds: while the remainder, broken in its descent by fragments of rocks, is in continual agitation. The noise, irregularity, and rapid descent of the stream, continue about

eight miles farther; and the river is not sufficiently calm to admit of navigation, till it reaches Queen's-town, on the west side of the straits of Niagara, and nine miles distant from the falls.

To attempt an adequate description of them would be a fruitless task. Their wondrous reality puts to flight the most sublime ideas of anticipating fancy, and overpowers the soul of an intelligent spectator, with such enthusiastic feelings as can never be rightly conceived, unless by those who have, on some occasion, contemplated a similar scene.

FALLS OF THE MONTMORENCY.

[*See Plate, No.* 46.]

The Montmorency empties itself at the distance of about eight miles north-east of Quebec, into the great river St. Laurence, to the coast of which it gradually descends from the elevated mountain on which it has its source. At a station called La Motte, situated on the northern extremity of a sloping ground, its waters diffuse themselves into shallow currents, interrupted by rocks which break them into foam, and accompanied by murmuring sounds which enliven the solitude and solemn stillness prevailing throughout the surrounding forests and desolate hills. Farther down, its channel is bounded by precipitous rocks, its breadth becoming extremely contracted, and the rapidity of its current proportionably augmented. At a place called "the natural steps" there are several beautiful cascades of ten or twelve feet. These steps, which are extremely regular, have been gradually formed by the accession of waters the river receives in its progress, at the breaking up of winter, by the melting of the snows. From the middle of April to the end of May, its waters roll with increasing height and rapidity. Being powerfully impelled in their course, they insinuate themselves between the strata of the horizontal rock, vast fragments of which are detached by the rushing violence of the sweeping torrent.

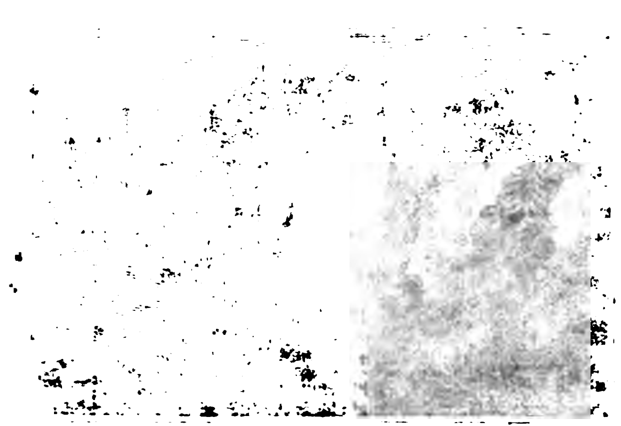
On the eastern side, the bank, which is almost perpendicular, and fifty feet high, is surmounted by lofty trees. The south-west bank rises beyond the steps, and terminates in a precipice. On the opposite side, the bank is regular, and of a singular shape, resembling the ruin of an elevated wall. The trees by which the banks are enclosed, united



No. 46.—Falls of Montmorenci.



No. 47.—St. Winifred's Well.





with the effect produced by the foaming currents, and the scattered masses of stone, form a scene wild and picturesque. The stream now taking a southern direction, is augmented in its velocity, and forms a grand cascade interrupted by huge rocks. A quarter of a mile further down a similar effect is produced. After exhibiting an agreeable variety through its course, the river is precipitated, in an almost perpendicular direction, over a rock two hundred and fifty feet in height. Wherever it touches the rock it falls in white clouds of rolling foam; and, beneath, where it is propelled with uninterrupted gravitation, it forms numerous flakes, like wool or cotton, which are gradually protracted in the descent, until they are received into the boiling profound abyss beneath.

The effect from the summit of the cliff is awfully grand, and truly sublime. The prodigious depth of the descent of the waters of this surprising fall; the brightness and volubility of their course; the swiftness of their movement through the air; and the loud and hollow noise emitted from the basin, swelling with incessant agitation from the weight of the dashing waters, forcibly combine to attract the attention, and to impress the mind of the spectator with sentiments of grandeur and elevation. The clouds of rising vapour, which assume the prismatic colours, contribute to enliven the scene. They fly off from the fall in the form of a revolving sphere, emitting with velocity pointed flakes of spray, which spread in receding, until they are interrupted by the neighbouring banks, or dissolved in the atmosphere.

The breadth of the fall is one hundred feet; and the basin, which is bounded by steep cliffs, forms an angle of forty-five degrees. When viewed from the beach, the cataract is seen, with resplendant beauty, to flow down the gloomy precipice, the summit of which is crowded with woods. The diffusion of the stream, to the breadth of fifteen hundred feet, and the various small cascades produced by the inequalities of its rocky bed, on its way to the river St. Lawrence, display a very singular and pleasing combination.

THE TUCCOA FALL.

This fall, in Franklin County, Georgia, is as yet scarcely known to the best informed of our geographers, and is notwithstanding one of the most beautiful that can be conceived. It is much higher than the great fall of Niagara; and the water is charmingly propelled over a perpendicular rock. When the stream is full, it passes down the steep in one expansive sheet magnificent to behold.

FALLS OF THE MISSOURI.

The most prominent features of this great American river which is fed by so many streams, having their sources in a great variety of soils and climates, are its wonderful falls, rapids, and cascades, the following connected view of which is abstracted from the very accurate draught and survey made by Captain Clarke.

This river is nine hundred feet wide at the point where it receives the waters of Medicine river, which is four hundred and one feet in width. The united current continues five thousand four hundred and twelve feet, somewhat more than a mile, to a small rapid on the north side, from which it gradually widens to four thousand two hundred feet, and at the distance of nine thousand and forty-two feet (nearly a mile and three-fourths) reaches the head of the Rapids, narrowing as it approaches them. Here the hills on the north, which had withdrawn from the bank, closely border the river, which, for the space of a mile, makes its way over the rocks with a descent of thirty feet: in this course the current is contracted to sixteen hundred and forty feet, and, after throwing itself over a small pitch of five feet, forms a beautiful cascade of twenty-six feet five inches; this does not, however, fall immediately perpendicular, being stopped by a part of the rock, which projects at about one-third of the distance. After descending this fall, and passing the Cotton-wood island, on which the eagle has fixed its nest, the river goes on for eight thousand seven hundred and seventy-eight feet (more than a mile and a half) over rapids and little falls, the estimated descent of which is thirteen feet six inches, till it is joined by a large fountain boiling up underneath the rocks near the edge of the river, into

which it falls with a cascade of eight feet. It is of the most perfect clearness, and rather of a bluish cast; and even after falling into the Missouri it preserves its colour for half a mile. From this fountain the river descends with increased rapidity for the distance of three thousand five hundred and thirty-one feet, during which the estimated descent is five feet: from this, for a distance of two thousand two hundred and twenty-seven feet, the river descends fourteen feet seven inches, including a perpendicular fall of six feet seven inches. The river has now become pressed into a space of one thousand four hundred and nineteen feet, and here forms a grand cataract, by falling over a plain rock, the whole distance across the river to the depth of forty-seven feet eight inches: after recovering itself, the Missouri then proceeds with an estimated descent of three feet, till at the distance of sixteen hundred and eighty-three feet it again is precipitated down the crooked falls of nineteen feet perpendicular; below this at the mouth of a deep ravine, is a fall of five feet, after which, for the distance of sixteen thousand and five feet (upwards of three miles) the descent is much more gradual, not being more than ten feet, and then succeeds a handsome level plain for the space of two thousand nine hundred and thirty-seven feet (more than half a mile,) with a computed descent of three feet, making a bend towards the north. Thence it descends, during seven thousand nine hundred and twenty feet, about eighteen feet and a half, when it makes a perpendicular fall of two feet, which is fourteen hundred and eighty-five feet beyond the great cataract, in approaching which it descends thirteen feet, within a distance of about six hundred feet, and gathering strength from its confined channel, which is only eight hundred and forty feet wide, rushes over the fall to the depth of eighty-seven feet and three quarters of an inch. After raging among the rocks, and losing itself in foam, it is compressed immediately into a bed of two hundred and seventy-nine feet in width; it continues for five thousand six hundred and ten feet to the entrance of a run or deep ravine, where there is a fall of three feet, which, joined to the decline of the river during that course, makes the descent six feet. As it goes on, the descent within the next three thousand nine hundred and sixty feet is only four

feet; from this, passing a run or deep ravine, the descent for one thousand six hundred feet is thirteen feet; within three thousand nine hundred and sixty feet, is a second descent of eighteen feet; thence two thousand six hundred and forty feet further, is a descent of six feet; after which, to the mouth of Portage creek, a distance of four thousand six hundred and twenty feet, the descent is ten feet.—From this survey and estimate it results that the river experiences a descent of three hundred and fifty-two feet in the course of two or three quarter miles, from the commencement of the rapids, to the mouth of Portage creek, exclusive of almost impassable rapids which extend for a mile below its entrance.

WATER-FALL OF SOUTH AFRICA.

The great chain of mountains which runs from north to south through the colony of the cape of Good Hope, divides into two branches, one of which stretches south-east, and the other due south. At the extremity of the latter branch is "the water-fall mountain," in one of the clefts of which a large stream of water falls from the high rock above, and presents, in the winter season, when swollen by the rains, a glorious spectacle. To view this fall to advantage, the traveller has to climb to a considerable height over the steep and broken rocks which form one side of the mountain, and, on reaching the top, sees it on the other side. Its height is estimated at between eighty and ninety feet, and its breadth at between thirty and forty. Adequate terms cannot be found to describe the sublimity of this scene, after abundant rains, when it is in its full beauty. In the vale beneath, the water is collected in a vast and deep basin, excavated in the stone; and by the side of the stream is a grotto, which runs within the rock to the depth of between thirty and forty feet. The arched entrance to this grotto is close to the falling water, when the stream is full. The rocks about it are thickly grown over with shrubs, which are then sprinkled by the spray. The European travellers who proceed from Cape Town to the interior of south Africa, seldom fail to make a pilgrimage to this enchanting spot.

CATARACTS OF THE NILE.

This celebrated river, through its long and fertile range of about two thousand British miles, in winding through abrupt and precipitous countries, exhibits very considerable cataracts, ten or twelve of which, having a descent of more than twenty feet, occur, before it reaches the level of Egypt. The one which, by way of eminence, is called the CATARACT OF THE NILE, was visited by Mr. Bruce, from whose relation the following particulars are extracted.

At the distance of half a mile beneath the cataract, the river is confined between two rocks, over which a strong bridge of a single arch has been thrown, and runs into a deep trough, with great roaring, and an impetuous velocity. On ascending, the cataract presents itself amid groves of beautiful trees, and exhibits a most magnificent and stupendous sight, such as, Mr. Bruce observes, ages, added to the greatest length of human life, could not efface or eradicate from his memory. It struck him with a kind of stupor, and total oblivion of where he was, as well as of every sublunary concern. At the time of his visit, the river had been considerably increased by rains, and fell in one sheet of water, above half an English mile in breadth, and to the depth of at least forty feet, with a force and noise which were truly terrific, and which, for a time, stunned him, and made him giddy. A thick fume, or haze, covered the fall in every part, and hung over the course of the stream both above and below, marking its track, although the waters were not seen. The river, although much swollen, preserved its natural clearness, and fell, partly into a deep pool, or basin, in the solid rock, and partly in twenty different eddies to the very foot of the precipice. In falling, a portion of the stream appeared to run back with great fury on the rock, as well as forward in the line of its course, raising waves, or violent ebullitions, which chafed against each other.

CATARACT OF THE MENDER.

The cataract which constitutes the source of this river, the Scamander of the ancients, is thus beautifully described

by Doctor Clarke. "Our ascent, as we drew near to the source of the river, became steep and rocky. Lofty summits towered above us, in the greatest style of Alpine grandeur; the torrent, in its rugged bed below, all the while foaming on our left. Presently we entered one of the sublimest natural amphitheatres the eye ever beheld; and here the guides desired us to alight. The noise of waters silenced every other sound. Huge craggy rocks rose perpendicularly, to an immense height; whose sides and fissures, to the very clouds, concealing their tops, were covered with pines. These grew in every possible direction, among a variety of evergreen shrubs; and enormous plane-trees waved their vast branches above the torrent. As we approached its deep gulf, we beheld several cascades, all of foam, pouring impetuously from chasms in the naked face of a perpendicular rock. It is said the same magnificent cataract continues all seasons of the year, wholly unaffected by the casualties of rain or melting snow. Having reached the chasms whence the torrent issues, we found, in their front, a beautiful natural basin, six or eight feet in depth, serving as a reservoir for the water during the first moments of its emission. It was so clear that the minutest object might be discerned at the bottom. The copious overflowing of this reservoir causes the appearance, to a spectator below, of different cascades, falling to the depth of about forty feet, but there is only one source. Behind are the chasms whence the water issues. We entered one of these, and passed into a cavern. Here the water appeared, rushing with great force, beneath the rock, towards the basin on the outside. The whole of the rock about the source was covered with moss; close to the basin grew hazel and plane trees; above were oaks and pines; and all beyond a naked and fearful precipice."

The bold and precipitous country of the Alps offers a variety of water falls and perpendicular torrents which are well deserving of notice; more particularly those in the vicinity of Mount Rosa, a part of the northern boundary of Piedmont. The river Oreo, fed by numerous streams from Mount St. Gothard, Mount Cenis, and several branches of the Appenines, forms, at Cerosoli a vertical cascade estimated at four hundred fathoms, or two thousand four hundred feet; while the torrent Evanson, de-

scending from another part of Mount Rosa, exhibits a fall of more than two hundred fathoms, rolling down pebbles of quartz, veined with the gold which is occasionally traced in the mountains of Challand. The CASCATA DEL MARMORE, or MARBLE CASCADE, so denominated from the mountain down which the Velcino falls being almost wholly of marble, lies about three miles from Terni. In proceeding towards it, the traveller is struck with terror on viewing the precipices, which are of a romantic height; but is sufficiently rewarded, when, on reaching the summit of the mountain, he regards the stupendous cataract, formed by the river as it rushes from the mountain. Having reached the declivity of its channel, the waters descend with a rapid course for a short space, and then fall from a perpendicular height of three hundred feet, breaking against lateral rocks, which cause vapours to ascend much higher than the summit of the cataract, by which the neighbouring valley receives a perpetual fall of rain. After this descent, the waters rush into the cavities of the rocks, and then bursting through several openings, at length reach the bed of the river.

The GRAND CASCADE OF THE ANIO, near Tivola, flows down the edge of a steep rock; and at its foot, the water, in a succession of ages, has hollowed grottoes of various shapes and sizes, so beautifully picturesque as to baffle all description. Of these, the grotto of Neptune is the most celebrated. Near to it are three smaller cascades, which rush murmuring through the ruins of the villa Mecænas, down the woody steep which forms the opposite bank of the river, and present the painter with one of the most picturesque views imaginable, the foreground varying beautifully at every step he takes.

In SAVOY, the Arvo flows many miles between high, craggy, and inaccessible rocks, which appear to have been purposely cleft to give its waters a free passage. The surprising echoes and continual sounds occasioned by its streams, the trampling of the horses and mules, the hallooing of passengers, &c.—are, in these places, reverberated three, four, and even in some parts six or seven times, with a noise so deep and wild, as to strike with terror the traveller who is unaccustomed to them; and the firing of a gun or pistol, is there more terrible than the loudest claps

of thunder. A steep precipice, with monstrous impending rocks, which seem ready to fall, joined to the roaring of the river, add largely to the general sublimity. The cataracts of this river are more or less loud and terrible, in proportion as the waters are more or less swollen by the melting snows, with which the tops of the mountains are covered. One in particular, called the NUN OF ARPENA, falls from a prodigiously high rock with great noise and violence: its descent is said to exceed eleven hundred feet.

In DALMATIA, the river Cettina forms a magnificent cascade, called by the inhabitants VELICA GUBAVISA, to distinguish it from a less fall a little below. The waters precipitate themselves from a height of above one hundred and fifty feet, forming a deep majestic sound, which is by the echo resounding between the steep and naked marble banks. Many broken fragments of rocks, which impede the course of the river after its fall, break the waves, and render them still more lofty and sonorous. By the violence of the repercussion, their froth flies off in small white particles, and is raised in successive clouds, which are scattered, by the agitation of the air, over the valley. When these clouds ascend directly upward, the inhabitants expect the noxious south-east wind called the sirocco.

The fall of the Staub-Bach, in the valley of Lauterbrannen, is estimated at nine hundred feet of perpendicular height; and about a league from Scaffhausen, at the village of Lauffen, in Switzerland, is a tremendous cataract of the Rhine, where that river precipitates itself from a rock said to be seventy feet in height, and not less than four hundred and fifty feet in breadth.

In Sweden, near Gottenburgh, the river Gotha rushes down from a prodigiously high precipice into a deep pit, with a dreadful noise, and with such amazing force, that the trees designed for the masts of ships, which are floated down the river, are usually turned upside down in their fall, and shattered in pieces. They frequently sink so far under water, as to disappear for a quarter of an hour, half an hour, and sometimes for three quarters of an hour. The pit into which the torrent precipitates them, is of a depth not to be ascertained, having been sounded with a line of several hundred fathoms, without the bottom being found.

In addition to the stupendous North American cataracts already described, may be noticed the one formed by the river Passaick, which discharges itself into the sea at the northern extremity of the State of New Jersey. About twenty miles from the mouth of this river, where it has a breadth of about a hundred and twenty feet, and runs with a very swift current, it reaches a deep chasm, or cleft, which crosses its channel, and falls about seventy feet perpendicular in one entire sheet. One end of the cliff is closed up, and the water rushes out of the other with incredible rapidity, in an acute angle to its former direction, and is received into a large basin. It thence takes a winding course through the rocks, and spreads again into a very considerable channel. The cleft is from four to twelve feet in breadth, and is supposed to have been produced by an earthquake. When this cataract was visited by a late British traveller, the spray formed two beautiful rainbows, primary and secondary, which greatly assisted in producing as fine a scene as the imagination can conceive. It was heightened by another fall, though of less magnificence, about ninety feet above. The falls of St. Anthony, on the river Mississippi, descend from a perpendicular height of thirty feet, and are nearly eight hundred feet in width, while the shore on each side is a level flat, without any intervening rock or precipice.

In ENGLAND, among the cataracts which merit a brief mention, may be cited the one in Devonshire, near the spot where the Tamer receives the small river Lid. The water there falls above a hundred feet: it proceeds from a mill at some distance, and after a course on a descent of nearly one hundred feet from the level of the mill, reaches the brink of the precipice, whence it falls in a most beautiful and picturesque manner, and, striking on a part of the cliff, rushes from it in a wider cataract to the bottom, where falling again with great violence, it makes a deep and foaming basin in the ground. This fine sheet of water causes the surrounding air at the bottom to be so impregnated with aqueous particles, that those who approach it find themselves in a mist.—In Cumberland there are several cataracts; but these are exceeded in beauty by a remarkable fall of the Tees, on the western side of the county of Durham, over which is a bridge suspended by chains, sel-

dom passed unless by the adventurous miners.—Asgarth force, in Yorkshire, is likewise a very interesting fall.

In SCOTLAND, the FALL OF FYERS, near Loch-Ness, is a vast cataract, in a darksome glen of a stupendous depth. The water rushes beneath, through a narrow gap between two rocks, and thence precipitating itself more than forty feet lower into the bottom of the chasm, the foam, like a great cloud of smoke, rises and fills the air. The sides of this glen are stupendous precipices, blended with trees overhanging the water, through which, after a short space, the waters discharge themselves into the lake. About half a mile to the south of this fall, is another which passes through a narrow chasm, whose sides it has undermined for a considerable distance. Over the gap is a true Alpine bridge, formed of the trunks of trees covered with sods, from the middle of which is an awful view of the water roaring beneath. In Perthshire, the river Keith presents a very considerable cataract, the noise produced by which is so violent as to stun those who approach it.—The western coast of Ross-shire is, however, peculiarly distinguished by these natural wonders, among which may be cited the grand cataract of the river Kirkag, and the cascade of Glamma, which latter being situated amid the constant obscurity of woody hills, is truly sublime.

In IRELAND, the noble river Shannon has a prodigious cataract, which, at about fifty miles from its mouth, prevents it from being longer navigable for vessels of a large burthen.

SPRINGS AND WELLS.

SAINT WINIFRED'S WELL.

[*See Plate, No.* 47.]

HOLYWELL, in Flintshire, is famous for ST. WINIFRED'S Well, one of the finest springs in the world. On account of the sanctity in which it was holden, it gave name to the town. This well pours out, each minute, *twenty-one tons of water,* which, running to the middle of the town, down the side of a hill, is made use of by every house as it passes, after which it turns several mills, and is employed in various

manufactures, which greatly increase the population of the place, and its neighbourhood. Over the spring, where a handsome bath has been erected, is a neat chapel, supported by pillars, and on the windows are painted the chief events of St. Winifred's, or, as it was anciently written Wenefrede's life. About the well grows moss, which the ignorant and superstitous devotees most stupidly imagine to be St. Winifred's hair. This saint is reported to have been a virgin Martyr, who lived in the seventh century, and, as the legend says, was ravished and beheaded in this place by a pagan tyrant; the spring having miraculously risen from her blood. Hence this bath was much frequented by Popish pilgrims, out of devotion, as well as by those who came to bathe in it for medicinal purposes. Mr. Pennant says, "the custom of visiting this well in pilgrimage, and offering up devotions there, is not yet entirely laid aside: in the summer a few are to be seen in the water, in deep devotion, up to their chins for hours, sending up their prayers, or performing a number of evolutions round the polygonal well."

It might have been supposed that the present enlightened age would have been secure against a repetition of impostures of this kind; but Doctor Milner, a Catholic Bishop, of Woolverhampton, has taken much pains to persuade the world that an ignorant proselyte, of the name of Winefrid White was there cured of various chronic diseases so late as the year 1804, by a miracle. Sir Richard Phillips, having, in the Monthly Magazine, referred this pretended miracle to the known effect of strong faith on ignorant minds, in any proposed means of cure, has been attacked by the catholic clergy for his incredulity; but in number 302 of the Monthly Magazine, he replies in the following words.

"We have no doubt whatever that Winefrid White was cured by her journey to Holywell, and by bathing in the wonderful natural spring at that place; but we are not credulous enough to believe that her cure was effected by any antagonist properties of the water to the cause of her disease—nor impious enough so to sport with ETERNAL OMNIPOTENCE as to assert that a capricious suspension of the laws of Nature took place for this purpose. On the contrary, we believe that the poor woman was cured by causes



No. 48.—Dropping Well at Knaresborough.



No. 49.—Water Spouts at Sea.

drop producing a musical kind of tinkling, probably owing to the concavity of the rock, which, bending in a circular projection, from the bottom to the top, occasions its brow to overhang about fifteen feet. This rock which is about thirty feet in height, forty-eight in length, and from thirty to fifty in breadth, started, in the year 1704, from the common bank, and left a chasm, from five to nine feet wide, over which the water passes by an aqueduct formed for the purpose. It is clothed with evergreen and other shrubs, which add greatly to the beauty of this very interesting scene.

The water is said to abound with fine particles of a nitrous earth, which it deposits, but when in a languid motion only, and leaves its incrustations on the leaves, moss, &c. which it meets with, in trickling thus slowly through the cavities of the rock. This spring is estimated to send forth twenty gallons of water in a minute. Here are to be seen pieces of moss, birds'-nests, with their eggs, and a variety of other objects, some of them very curious, which have been incrusted or petrified by the water.

WIGAN WELL.

About a mile from Wigan, in Lancashire, is a spring, the water of which burns like oil. On applying a lighted candle to the surface, a large flame is suddenly produced, and burns vigorously. A dishful of water having been taken up at the part whence the flame issues, and a lighted candle held to it, the flame goes out; notwithstanding which the water in this part boils and rises up like water in a pot on the fire, but does not feel warm on introducing the hand. What is still more extraordinary, on making a dam, and preventing the flowing of fresh water to the ignited part, that which was already there having been drained away, a burning candle being applied to the surface of the dry earth at the same point where the water before burned, the fumes take fire, and burn with a resplendant light, the cone of the flame ascending a foot and a half from the surface of the earth. It is not discoloured, like that of sulphureous bodies, neither has it any manifest smell, nor do the fumes, in their ascent, betray any sensible heat. The latter unquestionably consist of inflammable air, or hydrogen gas; and it ought to be ob-

served that the whole of the country about Wigan for the compass of several miles, is underlaid with coal. This phenomenon may therefore be referred to the same cause which occasioned the dreadful explosion of Felling Colliery; but in the present case, this destructive gas, instead of being pent up in the bowels of the earth, accompanies the water in its passage to the surface.

BROSELEY SPRING.

This celebrated boiling spring, or well, at Broseley, in Shropshire, was discovered in the month of June, 1711. It was first announced by a terrible noise in the night, there having been a remarkable thunder-storm. Several persons who resided in the vicinity having been awakened in their beds by this loud and rumbling noise, arose, and proceeding to a bog under a small hill, about two hundred yards from the river Severn, perceived a surprising commotion and shaking of the earth, and a little boiling up of water through the grass. They took a spade, and digging up a portion of the earth, the water immediately flew up to a great height, and was set on fire by a candle which was presented to it. To prevent the spring from being destroyed, an iron cistern has been placed over it, provided with a cover, and a hole in the centre, through which the water may be viewed. If a lighted candle or any burning substance, be presented to this aperture, the water instantly takes fire, and burns like spirit of wine, continuing to do so as long as the air is kept from it; but on removing the cover of the cistern, it quickly goes out. The apparent boiling and ascent of the water of this spring, are still more obviously the result of hydrogen gas, or inflammable air, than in the preceding instance of Wigan well.

HOT SPRINGS OF ST. MICHAEL.

In the eastern part of this island, or one of the Azores, is a round deep valley surrounded by high mountains, in which are many hot springs; but the most remarkable is that called THE CALDEIRA, situated in the eastern part of the valley on a small eminence by the side of a river, on which is a basin about thirty feet in diameter, where the water continually boils with prodigious fury. A few yards distant from it is

a cavern in the side of a bank, in which the water boils in a dreadful manner, throwing out a thick, muddy, unctuous water, several yards from its mouth, with a hideous noise. In the middle of the river are several places where the water boils with so intense a heat, that a person cannot dip his finger into it without being scalded. On its banks are several apertures, out of which the steam rises to a considerable height, and is so hot that it cannot be approached by the hand. In other parts, the spectator would be led to suppose that the bellows of a hundred forges are blowing in concert; while sulphureous streams issue out in a thousand places. The bushes even, near these spots, are covered with pure brimstone, condensed from the steam which issues from the ground. In the small caverns whence the steam issues, many of the inhabitants prepare their food.

HOT SPRINGS OF THE TROAS.

The Troas, a country of Phrygia, in Asia Minor, of which Troy was the capital, abounds with hot springs; the most interesting one of which is thus described by Doctor Clarke. It is situated near a place called Bonarbashy, signifying literally "*The head of the springs*," and gushes perpendicularly out of the earth, rising from the bottom of a marble and granite reservoir, and throwing up as much water as the famous fountain of Holywell in Flintshire. Its surface seems vehemently boiling; and, during cold weather, the condensed vapour above it, causes the appearance of a cloud of smoke over the well. While the mercury stood at 46° in the open air, it rose, when the thermometer was plunged in the water, to 62°.—Notwithstanding the warmth of this spring, fishes were seen sporting in the reservoir. In every part of the district through which the Mender flows, from Ida to the Hellespont, are many of these springs, of different degrees of temperature.

The Geysers have already been described, in treating of Mount Hecla, and its surprising volcano. In following up the details of the phenomena of this nature given above, by a brief notice of other bubbling, tepid, and boiling springs, it may not be improper to premise that heat, water, and vapours of various kinds, exist in prodigious

quantities beneath the surface of the earth; and frequently, as has been seen in the phenomena of volcanoes and earthquakes, burst forth from enormous openings, with tremendous destruction. It often happens, however, that the openings are small and porous, and that the vapours ascending through them, are simply combined with water. Hence that almost infinite variety in the characters of these springs, fountains, and lakes, the waters of which are combined with extraneous substances. In some cases the elastic gases, or vapours, ascend from specific levity alone, and are destitute of all taste and odour; insomuch that springs are found which bubble without boiling, or betraying heat or any other foreign quality. In other cases they are strongly impregnated with heat; and are then either tepid or boiling, according to the proportion of extricated caloric they contain. Occasionally, whether hot or cold, they are blended with metallic, sulphureous, saline, and other substances, and hence assume the name of mineral waters; while, if the substance thus dissolved be combustible, as naphtha, bitumen, or turpentine, the fountain will often inflame and burn on the application of a lighted torch.

The water of the noted BOILING SPRING AT PEROUL, near Montpelier, is observed to heave and boil up very furiously in small bubbles, which manifestly proceed from a vapour breaking out of the earth, and rushing through the water, so as to throw it up with noise, and in many bubbles; for on digging in the vicinity of the ditch where the spring lies, and pouring fresh water on the dry spot newly dug, the same boiling is immediately observed. A similar bubbling of the water is likewise found near Peroul on the sea shore. In several dry places near the spring, are small venti-ducts, passages, or clefts, whence steam issues; and at the mouths of these passages, small light bodies, such as feathers, pieces of straw, leaves, &c. being placed, are soon blown away. This vapour, on the application of a lighted candle or torch, does not flame or take fire, as is the case with that of the boiling spring at Wigan; so that there are two different sorts of steam, to occasion these boilings, at the same time that neither of the fountains is medicinal, or even warm.

Other boiling waters, of a very different temperature

possess, like those of the hot springs of St. Michael, a sufficient degree of heat to boil eggs, and to serve for other culinary purposes. Among these may be instanced those of the SOLFATARA, near Naples; those on the summit of Mount Zebio, in the Modenese territory; and those which constitute the source of the imperial bath at Aix la Chapelle. In JAPAN, a hot spring is said to burst forth which constantly maintains the boiling point, and the water of which retains its heat much longer than common water. It does not flow regularly, but during an interval of two hours each day; and the force and violence of the vapours are then so great, that large stones are ejected, and raised to the height of ten or twelve feet, with a noise like that of the explosion of a piece of artillery.

From the phenomena which have been adduced, it appears that the exhalations constantly escaping from the vast subterraneous magazines in which they are prepared, vary greatly in their qualities and effects. Some are cold and dry, resembling air or wind, as those near Peroul, and in the cavities of mountains, especially those of Æolus, and other hills of Italy; as well as in particular mines. Others are inflammable, and of a bituminous nature, though not positively warm, as those of Wigan well.—Others are very hot, sulphureous, and saline, more especially those of the natural stoves, sweating vaults, grottoes, baths, and volcanoes near Naples, Baiæ, Cuma, and Puzzuoli, as also in some of the subterraneous works at Rome. And others, again, are of an arsenical, or other noxious quality, as those of the Grotta del Cane. Now, these various streams meeting with, and running through water, must occasion in it a great variety of phenomena and effects.

It is observed by Doctor Thomson, in his history of the Royal Society, that the HOT SPRING AT BATH has continued at a temperature higher than that of the air for a period of not less than two thousand years, although it is so far distant from any volcano, that, without a very violent and improbable extension of the agency of volcanic fires, it cannot be ascribed to them. There are various decompositions of mineral bodies, which generate considerable heat; or, to speak more properly, water is itself the decomposed substance generating heat by its decomposition.

The evolution of azotic gas is a proof that the heat of the Bath waters is owing to a particular decomposition which takes place within the bowels of the earth. The greatest heat of these waters, is 116° of Fahrenheit's scale; but that of the mineral waters of Carlsbad, in Bohemia, ascends to 165°.

RECIPROCATING FOUNTAINS, OR SPRINGS, may be cited among the most curious phenomena of nature. An irregularity of flow is not uncommon in boiling springs; but there are other springs which evince a periodical influx and reflux almost as regular as the tides of the ocean.—These changes, it will be seen, frequently occur several times in a day, or even in an hour. They are ascribed to various causes, either subterraneous, or superficial; but in general, springs and lakes of this description have been ascertained to communicate with others beneath, through pores or apertures of various diameters, which serve equally to carry off the waters, and to supply them afresh. In such cases the flux and reflux of the upper head of water, must necessarily, depend on the state of that beneath; and the causes which alternately augment and diminish the latter, must produce a similar effect on the former.

PADERBORN SPRING, in Westphalia, disappears twice in twenty-four hours, returning constantly, after a lapse of six hours, with a great noise, and so forcibly as to drive three mills at a short distance from its source. The inhabitants call it *the bolderborn*, that is, the boisterous spring. LAY-WELL spring, near Torbay, is about six feet in length, five in breadth, and nearly six inches deep. The flux and reflux, which are very visible, are performed in about two minutes; when the spring remains at its lowest ebb for the space of about three minutes. In this way it ebbs and flows twenty times within the hour. As soon as the water begins to rise, many bubbles ascend from the bottom; but on its falling, the bubbling instantly ceases.—GIGGLESWICK SPRING, in the West Riding of Yorkshire, lies at the foot of a hill of limestone named Giggleswick Soar. Its reciprocations are irregular, both with respect to duration and magnitude, the interval of time between any two succeeding flows being sometimes greater, and at other times less, insomuch that a just standard of comparison cannot be formed. The rise of

the water, in the stone trough, or cistern, which receives it, during the time of the well's flowing, is equally uncertain, varying from one inch to nine or ten inches, in the course of a few reciprocations. This spring, like the preceding one, discharges bubbles of air at the time of its flowing.—Near the LAKE OF BOURGET, in Savoy, is a reciprocating spring which rises and falls with a great noise, but not at stated and regular times. After Easter, its ebbings and flowings are frequently perceived six times in an hour; but in dry seasons not more than once or twice. It issues from a rock, and is called *la Fontaine de Merville*, the marvellous fountain.

BITUMINOUS AND OTHER LAKES.

PITCH LAKE OF TRINIDAD.

NEAR point LA BRAYE, TAR POINT, the name assigned to it on account of its characteristic feature, in the Island of Trinidad, is a Lake which at the first view appears to be an expanse of still water, but which, on a nearer approach, is found to be an extensive plain of mineral pitch, with frequent crevices and chasms filled with water.—On its being visited in the autumnal season, the singularity of the scene was so great, that it required some time for the spectators to recover themselves from their surprise, so as to examine it minutely. The surface of the lake was of an ash colour, and not polished or smooth, so as to be slippery, but of such a consistence as to bear any weight. It was not adhesive, although it received in part the impression of the foot, and could be trodden without any tremulous motion, several head of cattle browsing on it in perfect security. In the summer season, however, the surface is much more yielding, and in a state approaching to fluidity, as is evidenced by pieces of wood and other substances, recently thrown in, having been found enveloped in it. Even large branches of trees, which were a foot above the level, had, in some way, become enveloped in the bituminous matter. The interstices, or chasms, are very numerous, ramifying and joining in every

direction; and being filled with water in the wet season, present the only obstacle to walking over the surface.—These cavities are in general deep in proportion to their width, and many of them unfathomable: the water they contain is uncontaminated by the pitch, and is the abode of a variety of fishes. The arrangement of the chasms is very singular, the sides invariably shelving from the surface, so as nearly to meet at the bottom, and then bulging out towards each other with a considerable degree of convexity. Several of them have been known to close up entirely, without leaving any mark or seam.

The pitch lake of Trinidad contains many islets covered with grass and shrubs, which are the haunts of birds of the most exquisite plumage. Its precise extent cannot, any more than its depth, be readily ascertained, the line between it and the neighbouring soil not being well defined; but its main body may be estimated at three miles in circumference. It is bounded on the north and west sides by the sea, on the south by a rocky eminence, and on the east by the usual argillaceous soil of the country.

MUD LAKE OF JAVA.

The following details relative to the volcanic springs of boiling mud in Java are extracted from the Penang Gazette.

Having received an extraordinary account of a natural phenomenon in the plains of Grobogna, fifty paals north-east of Solo; a party set off from *Solo* the 25th Sept. 1814, to examine it.—On approaching the dass or village of Kuhoo, they saw between two topes of trees in a plain, an appearance like the surf breaking over rocks with a strong spray falling to leeward. Alighting, they went to the 'Bluddugs,' as the Javanese call them. They are situated in the village of Kuhoo, and by Europeans are called by that name. "We found them says the narrator, to be an elevated plain of mud about two miles in circumference, in the centre of which, immense bodies of soft mud were thrown up to the height of ten to fifteen feet, in the form of large bubbles, which, bursting, emitted great volumes of dense white smoke.—These large bubbles, of which there were two, continued throwing up and bursting seven or eight times in a minute; at times they threw up two or three tons of mud. The

party got to the leeward of the smoke, and found it to stink like the washings of a gunbarrel.—As the bubbles burst, they threw the mud out from the centre, with a pretty loud noise, occasioned by the falling of the mud on that which surrounded it, and of which the plain is composed. It was difficult and dangerous to approach the large bubbles, as the ground was all a quagmire, except where the surface of the mud had become hardened by the sun;—upon this, we approached cautiously to within fifty yards of one of the largest bubbles, or mud-pudding, as it might properly be called, for it was of the consistency of custard-pudding, and was about a hundred yards in diameter:—here and there, where the foot accidentally rested on a spot not sufficiently hardened to bear, it sunk—to the no small distress of the walker.

"We also got close to a small bubble, (the plain was full of them, of different sizes,) and observed it attentively for some time. It appeared to heave and swell, and, when the internal air had raised it to some height, it burst, and the mud fell down in concentric circles; in which state it remained quiet until a sufficient quantity of air again formed internally to raise and burst another bubble, and this continued at intervals of from about half a minute to two minutes.

"From various other parts of the pudding round the large bubbles, there were occasionally small quantities of sand shot up like rockets to the height of twenty or thirty feet, unaccompanied by smoke:—this was in parts where the mud was of two stiff a consistency to rise in bubbles. The mud at all places we came near was cold.

"The water which drains from the mud is collected by the Javanese, and, being exposed in the hollows of split bamboos to the rays of the sun, deposits crystals of salt. The salt thus made is reserved exclusively for the use of the Emperor of Solo; in dry weather it yields thirty dudgins of 100 catties each, every month, but, in wet or cloudy weather, less.

"Next morning we rode two and a half paals to a place in a forest called Ram am, to view a salt lake, a mud hillock, and various boiling pools.

"The lake was about half a mile in circumference, of a dirty-looking water, boiling up all over in gurgling eddies

but more particularly in the centre, which appeared like a strong spring. The water was quite cold, and tasted bitter, salt, and sour, and had an offensive smell.

About thirty yards from the lake stood the mud-hillock, which was about fifteen feet high from the level of the earth. The diameter of its base was about twenty-five yards, and its top about eight feet—and in form an exact cone. The top is open, and the interior keeps constantly boiling and heaving up like the bluddugs. The hillock is entirely formed of mud which has flowed out of the top. Every rise of the mud was accompanied by a rumbling noise from the bottom of the hillock, which was distinctly heard for some seconds before the bubble burst;—the outside of the hillock was quite firm. We stood on the edge of the opening and sounded it, and found it to be eleven fathoms deep. The mud was more liquid than at the bluddugs, and no smoke was emitted either from the lake, hillock, or pools.

"Close to the foot of the hillock was a small pool of the same water as the lake, which appeared exactly like a pot of water boiling violently;—it was shallow, except in the centre, into which we thrust a stick twelve feet long, but found no bottom. The hole not being perpendicular, we could not sound it without a line.

"About 200 yards from the lake were two very large pools or springs, eight and twelve feet in diameter; they were like the small pool, but boiled more violently and stunk excessively. We could not sound them for the same reason which prevented our sounding the small pool.

"We heard the boiling thirty yards before we came to the pools, resembling the noise of a waterfall. These pools did not overflow—of course the bubbling was occasioned by the rising of air alone. The water of the bluddugs and of the lake is used medicinally by the Javanese."

ATMOSPHERICAL PHENOMENA.

METEORS.

From look to look, contagious through the croud,
The panic runs, and into wond'rous shapes
The appearance throws: armies in meet array,
Thronged with aerial spears and steeds of fire;
Till the long-lines of full-extended war
In bleeding fight commixt, the sanguine flood
Rolls a broad slaughter o'er the plains of heaven.
As thus they scan the visionary scene,
On all sides swells the superstitious din,
Incontinent; and busy frenzy talks
Of blood and battle; cities overturned,
And late at night in swallowing earthquake sunk,
Or hideous wrapt in fierce ascending flame;
Of sallow famine, inundation, storm;
Of pestilence, and every great distress;
Empires subversed, when ruling fate has struck
The unalterable hour: even nature's self
Is deemed to totter on the brink of time.
Not so the man of philosophic eye,
And aspect sage; the waving brightness he
Curious surveys, inquisitive to know
The causes, and materials, yet unfixed,
Of this appearance beautiful and new.

THOMSON.

THE nature of these splendid phenomena of the heavens cannot be so well elucidated as by an extract from the travels of M. M. Humboldt and Bonpland to the equinoctial regions of the New Continent. The sublime wonders described by the former of these travellers were witnessed by them at Cumana, a city of South America, and capital of the province of that name.

"The night of the 11th of November, 1779, was cool and extremely beautiful. Toward the morning, from half after two, the most extraordinary luminous meteors were seen towards the east. M. Bonpland, who had risen to enjoy the freshness of the air in the gallery, perceived them first. Thousands of bolides, (fire-balls,) and falling stars, succeeded each other during four hours. Their direction was very regular, from north to south. They filled a space in the sky extending from the true east 30° towards the

north and south. In an amplitude of 60° the meteors were seen to rise above the horizon at east-north-east, and at east to describe arcs more or less extended, falling toward the south, after having followed the direction of the meridian. Some of them attained a height of 40°; and all exceeded 25° or 30°. There was very little wind in the low regions of the atmosphere, and this blew from the east. No trace of clouds was to be seen. M. Bonpland relates, that from the beginning of the phenomenon, there was not a space in the firmament equal in extent to three diameters of the moon, which was not filled at every instant with bolides and falling stars. The first were fewer in number, but as they were seen of different sizes, it was impossible to fix the limit between these two classes of phenomena.— All these meteors left luminous traces from five to ten degrees in length, as often happens in the equinoctial regions. The phosphoresence of these traces, or luminous bands, lasted seven or eight seconds. Many of the falling stars had a very distinct nucleus, as large as the disc of Jupiter, from which darted sparks of vivid light. The bolides seemed to burst as by explosion; but the largest, those from 1° to 1° 15′ in diameter, disappeared without scintillation, leaving behind them phosphorescent bands (*trabes*) exceeding in breadth fifteen or twenty minutes, or sixtieth parts of a degree. The light of these meteors was white, and not reddish, which must be attributed, no doubt, to the absence of vapours, and the extreme transparency of the air. For the same reason, under the tropics, the stars of the first magnitude have, at their rising, a light evidently whiter than in Europe.

"Almost all the inhabitants of Cumana were witnesses of this phenomenon, and did not behold these bolides with indifference; the oldest among them remembered, that the great earthquakes of 1766 were preceded by similar phenomena. The fishermen in the suburbs asserted, that the *fire-work* had begun at one o'clock; and that, as they returned from fishing in the Gulf, they had already perceived very small falling stars towards the east. They affirmed at the same time, that igneous meteors were extremely rare on those coasts after two in the morning.

"The phenomenon ceased by degrees after four o'clock, and the bolides and falling stars became less frequent;

but we still distinguished some toward the north-east, by their whitish light, and the rapidity of their movement, a quarter of an hour after sun-rise. This circumstance will appear less extraordinary, when I state that in full day light, in 1788, the interior of the houses in the town of Popayan was highly illumined by an aerolite of immense magnitude. It passed over the town when the sun was shining clearly, about one o'clock. M. Bonpland and myself, during our second residence at Cumana, after having observed on the 26th of September, 1800, the immersion of the first satellite of Jupiter, succeeded in seeing the planet distinctly with the naked eye, eighteen minutes after the disc of the sun had appeared in the horizon. There was a very slight vapour in the east, but Jupiter appeared on an azure sky. These facts prove the extreme purity and transparency of the atmosphere under the torrid zone. The *mass* of diffused light is so much less, as the vapours are more perfectly dissolved. The same cause that weakens the diffusion of the solar light, diminishes the extinction of that which emanates either from a bolis, Jupiter, or the moon, seen on the second day after her conjunction.

"The researches of M. Chladni having singularly fixed the attention of the scientific world upon the bolides and falling stars at my departure from Europe, we did not neglect during the course of our journey from Caraccas to the Rio Negro, to enquire every where, whether the meteors of the 12th of November had been perceived. In a savage country, where the greater number of the inhabitants sleep out in the air, so extraordinary a phenomenon could not fail to be remarked, except when concealed by clouds from the eye of observation. The Capuchin missionary at San Fernando de Apura, a village situated amid the savannahs of the province of Varinas; and the Franciscan monks stationed near the cataracts of the Oroonoko, and at Maroa, on the banks of the Rio Negro; had seen numberless falling stars and bolides illumine the vault of heaven. Maroa is south-west of Cumana, at one hundred and seventy-four leagues distance. All these observers compared the phenomenon to a beautiful fire-work, which had lasted from three till six in the morning. Some of the monks had marked the day upon their ritual; others had noted it by the nearest festivals of the church. Unfortu-

nately, none of them could recollect the direction of the meteors, or their apparent height. From the position of the mountains and thick forests which surround the missions of the cataracts and the little village of Maroa, I presume that the bolides were still visible at 20° above the horizon. On my arrival at the southern extremity of Spanish Guyanna, at the little fort of San Carlos, I found a party of Portuguese, who had gone up the Rio Negro from the Mission of St. Joseph of the Maravitains, and who assured me, that in that part of Brazil, the phenomenon had been perceived, at least as far as San Gabriel das Cachoeiras, consequently as far as the equator itself.

"I was powerfully struck at the immense height which these bolides must have attained, to have been visible at the same time at Cumana, and on the frontiers of Brazil, in a line of two hundred and thirty leagues in length. But what was my astonishment, when at my return to Europe, I learnt, that the same phenomenon had been perceived on an extent of the globe of 64° of latitude, and 91° of longitude; at the equator, in South America, at Labrador, and in Germany! I found accidentally during my passage from Philadelphia to Bordeaux, in the memoirs of the Pennsylvanian Society, the corresponding observations of Mr. Ellicott (lat. 30° 42'); and, upon my return from Naples to Berlin, I read the account of the Moravian Missionaries among the Eskimoes, in the library of Gottingen.—Several philosophers had already discussed at this period the coincidence of the observation in the north with those at Cumana, which M. Bonpland and I had published in 1800.

"The following is a succinct enumeration of facts:—1st, the fiery meteors were seen in the east, and the east-north-east, to 40° of elevation, from 2 h. to 6 h. at Cumana (lat. 10° 27' 52", long. 66° 30'); at Porto Cabello (lat. 10° 6' 52", long. 67° 5'); and on the frontiers of Brazil, near the equator, in the longitude of 70° west of the meridian of Paris. 2d, In French Guiana (lat. 4° 56', long. 54° 35'), the northern part of the sky was seen all on fire. Innumerable falling stars traversed the heavens during an hour and a half, and diffused so vivid a light, that those meteors might be compared to the blazing sheaves shot out from a firework. 3d, Mr. Ellicott, astronomer to the United States, hav-

ing terminated his trigonometric operations for the rectification of the limits on the Ohio, being, on the 12th of November, in the Gulf of Florida, in the latitude of 25°, and longitude 81° 50′, saw, in all parts of the sky, 'as many meteors as stars, moving in all directions: some appeared to fall perpendicularly; and it was expected every minute that they would drop into the vessel.' The same phenomenon was perceived upon the American continent as far as the latitude of 30° 42′. 4th, In Labrador, at Nain (lat. 56° 55′,) and Hoffenthal (lat. 58° 4′); in Greenland, at Lichtenau (lat. 61° 5′), and at New Herrenhut (lat. 64° 14′, long. 52° 20′); the Eskimoes were frightened at the enormous quantity of bolides which fell during twilight toward all points of the firmament, some of them being a foot broad. 5th, In Germany, M. Zeissing, vicar of Itterstadt near Weimar (lat. 50° 59′, long 9° 1′ east), perceived, on the 12th of November, between the hours of six and seven in the morning, when it was half after two at Cumana, some falling stars, which shed a very white light. Soon after, toward the south and south-west, luminous rays appeared from four to six feet long: they were reddish, and resembled the luminous track of a sky-rocket. During the morning twilight, between the hours of seven and eight, the south-west part of the sky was seen, from time to time, strongly illuminated by white lightning, which ran in serpentine lines along the horizon. At night the cold increased, and the barometer rose.

"The distance from Weimar to the Rio Negro, is 1800 sea leagues; and from Rio Negro to Herrenhut in Greenland, 1300 leagues. Admitting that the same fiery meteors were seen at points so distant from each other, we must also admit, that their height was at least 411 leagues. Near Weimar, the appearance like sky-rockets was seen in the south, and south-east; at Cumana, in the east, and in the east-north-east. We may therefore conclude, that numberless aerolites must have fallen into the sea, between Africa and South-America, to the west of the Cape-Verde Islands. But, since the direction of the bolides was not the same at Labrador and at Cumana, why were they not perceived in the latter place towards the north, as at Cayenne? I am inclined to think, that the Chayma Indians of Cumana did not see the same bolides as the Portuguese in Brazil,

and the missionaries in Labrador; but, at the same time, it cannot be doubted, and this fact appears to me very remarkable, that in the New World, between the meridians of 46° and 8[illegible]°, between the equator and 64° north, at the same hour, an immense number of bolides and falling stars were perceived; and that those meteors had every where the same brilliancy, throughout a space of 921,000 square leagues.

"The scientific men who have lately made such laborious researches on falling stars and their parallaxes, consider them, as meteors belonging to the farthest limits of our atmosphere, between the region of the Aurora Borealis and that of the lightest clouds. Some have been seen, which had not more than 14,000 toises, or about five leagues of elevation. The highest do not appear to exceed thirty leagues. They are often more than a hundred feet in diameter; and their swiftness is such, that they dart, in a few seconds, over a space of two leagues. Some of these have been measured, the direction of which was almost perpendicularly upward, or forming an angle of 50° with the vertical line. This extremely remarkable circumstance has led to the conclusion, that falling stars are not *aerolites*, which, after having hovered about a long time in space, take fire on entering accidentally into our atmosphere, and fall towards the earth.

"Whatever may be the origin of these luminous meteors, it is difficult to conceive any instantaneous inflammation taking place in a region, where there is less air than in the vacuum of our air-pumps; and where (25,000 toises high) the mercury in the barometer would not rise to 0·012 of a line. We have ascertained the uniform mixture of atmospheric air to 0·003 nearly, only to an elevation of 3000 toises: consequently, not beyond the last stratum of fleecy clouds. It might be admitted, that, in the first revolutions of the globe, gaseous substances which yet remain unknown to us, may have risen towards that region, through which the falling stars pass: but accurate experiments, made upon mixtures of gases which have not the same specific gravity, prove, that we cannot admit a superior stratum of the atmosphere entirely different from the inferior strata. Gaseous substances mix and penetrate each other with the least motion; and a uniformity of their mixture would have

taken place in the lapse of ages, unless we suppose in them the effects of a repulsive action unexampled in those substances which we can subject to our observations.—Farther, if we admit the existence of a particular aerial fluid in the inaccessible region of luminous meteors, falling stars, bolides, and the Aurora Borealis, how can we conceive why the whole stratum of those fluids does not at once take fire; but that the gaseous emanations, like the clouds, occupy only limited spaces? How can we suppose an electrical explosion without some vapours collected together, capable of containing unequal charges of electricity, in air, the mean temperature of which is, perhaps, 25° below the freezing point of the centigrade thermometer, and the rarefaction of which is so considerable, that the compression of the electrical shock could scarcely disengage any heat? These difficulties would in great part, be removed, if the direction of the motion of falling stars allowed us to consider them as bodies with a solid nucleus, as cosmic phenomena (belonging to space beyond the limits of our atmosphere) and not as telluric phenomena (belonging to our planet only.)

"Supposing that the meteors of Cumana were only at the usual height at which falling stars in general move, the same meteors were seen above the horizon in places more than 310 leagues distant from each other. Now, what an extraordinary disposition to incadescence must have reigned on the 12th of November, in the higher regions of the atmosphere, to have furnished, during four hours, myriads of bolides and falling stars, visible at the equator, in Greenland, and in Germany.

"Mr. Benzenberg judiciously observes, that the same cause, which renders the phenomenon more frequent, has also an influence on the largeness of the meteors, and the intensity of their light. In Europe, the nights when there are the greatest number of falling stars, are those in which very bright ones are mixed with very small ones. The periodicalness of the phenomenon augments the interest which it excites. There are months, in which M. Brandes has reckoned in our temperate zone, only sixty or eighty falling stars in one night; and in other months their number has risen to two thousand. Whenever one is observed, which has the diameter of Sirius or of Jupiter, we are sure of seeing so brilliant a meteor succeeded by a great number

of smaller meteors. If the falling stars be very frequent during one night, it is very probable that this frequency will continue during several weeks. It would seem that, in the higher regions of the atmosphere, near that extreme limit where the centrifugal force is balanced by gravity, there exists, at regular periods, a particular disposition for the production of bolides, falling stars, and the Aurora Borealis. Does the periodicalness of this great phenomenon depend upon the state of the atmosphere? or upon something which the atmosphere receives from without, while the earth advances in the eliptic? Of all this we are still ignorant as men were in the days of Anaxagoras.

"With respect to the falling stars themselves, it appears to me, from my own experience, that they are more frequent in the equinoctial regions than in the temperate zone; more frequent over the continents, and near certain coasts, than in the middle of the ocean. Do the radiation of the surface of the globe, and the electrical charge of the lower regions of the atmosphere, which varies according to the nature of the soil, and the positions of the continents and seas, exert their influence as far as those heights, where eternal winter reigns? The total absence even of the smallest clouds, at certain seasons, or above some barren plains destitute of vegetation, seems to prove, that this influence can be felt at least as far as five or six thousand toises high. A phenomenon analogous to that of the twelfth of November, was observed thirty years before, on the table-land of the Andes, in a country studded with volcanoes. At the city of Quito, there was seen, in one part of the sky, above the volcano of Gayambo, so great a number of falling stars, that the mountain was thought to be in flames. This singular sight lasted more than an hour. The people assembled in the plain of Exico, where a magnificent view presents itself of the highest summit of the Cordilleras. A procession was already on the point of setting out from the Convent of St. Francis, when it was perceived, that the blaze of the horizon was caused by fiery meteors, which ran along the skies in all directions, at the altitude of twelve or thirteen degrees."

The bolides, or fire-balls, and falling stars, so striking an example of which is given above, are of all sizes, from a small shooting star of the fifth magnitude, to a cone or cylinder of two or three miles in diameter. They differ

in consistency as much as in dimensions, and in colour as much as in either. Occasionally, they are a subtile, luminous and pellucid vapour; and sometimes a compact ball, or globe, as though the materials of which they are formed, were more condensed and concentrated. Not unfrequently they have been found to consist of both, and consequently to assume a comet-like appearance, with a nucleus or compact substance in the centre, or towards the centre, and a long, thin, pellucid, or luminous main, or tail, sweeping on each side. They are sometimes of a pale white light; at others, of a deep igneous crimson; and, occasionally irridescent and vibratory. The rarer meteors appear frequently to vanish on a sudden, as though abruptly dissolved or extinguished in the atmospheric medium, their flight being accompanied by a hissing sound, and their disappearance by an explosion. The most compact of them, or the nuclei of those which are rarer, have often descended to the surface of the earth, and with a force sufficient to bury them many feet under the soil; generally exhibiting marks of imperfect fusion and considerable heat. The substance is, in these cases, for the greater part metallic; but the ore of which they consist is not any where to be found, in the same constituent proportions, in the bowels of the earth. Under this form the projected masses are denominated aerolites, or meteoric stones.

It may not be uninteresting to preface a succinct account of the most surprising of these meteors, by a brief notice of the hypotheses which have been imagined concerning them; however justly the learned Humboldt may have concluded, in the words of the extract given above, that we are still "as ignorant on this subject as men were in the days of Anaxagoras." Sir J. Pringle contended, with other philosophers, that they are revolving bodies, or a kind of terrestrial planets. Doctor Halley conjectured them to consist of combustible vapours, accumulated and formed into concrete bodies on the outskirts, or extreme regions of the atmosphere, and to be suddenly set on fire by some unknown cause; an opinion which, with little difference, has been since entertained by Sir. W. Hamilton and Dr. King. Dr. Blagdon regarded them altogether as electrical phenomena. M. Izarn believed them to consist of volcanic materials, propelled into the atmosphere in the course of explo-

sions of great violence. M. Chladni supposed them to be formed of substances existing exteriorly to the atmosphere of the earth, and other planets, which have never incorporated with them, and are found loose in the vast ocean of space, being there combined and inflamed by causes unknown to us. Lastly, the most favourite hypothesis is, that the whole, or, at least, the more compact division of these meteors, are made up of materials thrown from immense volcanoes in the moon. This hypothesis, which was started by M. Olbers, in 1795, has been since very plausibly supported by the celebrated Laplace, but does not apply to the smaller and less substantial meteors, named shooting stars. Hence these philosophers derive the latter phenomena from some other cause, as electricity, or terrestrial exhalations; and observe, in support of the distinction they find it necessary to make, that shooting stars must be of a different nature from fire-balls, since they sometimes appear to ascend as well as to fall. This observation has been especially dwelt on by MM. Chladni and Benzenburg, both of them favourably noticed, as accurate observers, by Humboldt.

On the 21st of March, 1676, two hours after sunset, an extraordinary meteor was seen to pass over Italy. At Bononia, its greatest altitude in the south-south-east was 38°; and at Sienna, 58° towards the north-north east. In its course, which was from east-north-east to west-south-west, it passed over the Adriatic sea, as if coming from Dalmatia. It crossed all Italy, being nearly vertical to Rimini and Savigniano, on the one side, and to Leghorn on the other: its perpendicular altitude was at least thirty-eight miles. At all the places near its course it was heard to make a hissing noise as it passed, like that of artificial fire-works. In passing over Leghorn, it gave a very loud report, like that of a cannon; immediately after which another sort of sound was heard, like the rattling of a deeply-loaded waggon passing over the stones, which continued for several seconds. The professor of mathematics at Bononia calculated the apparent velocity of this surprising meteor at not less than one hundred and sixty miles in a minute of time, which is above ten times as swift as the diurnal rotation of the earth under the equinoctial, and not many times less than that with which the annual motion of the earth about the sun is

performed. It there appeared larger than the moon in one diameter, and above half as large again in the other; which, with the given distance of the eye, made its real smaller diameter above half a mile, and the larger one in proportion. It is, therefore, not surprising, that so great a body, passing with such an amazing velocity through the air, however rarified it may be in its upper regions, should occasion so loud a hissing noise as to be heard at such a distance. It finally went off to sea towards Corsica.

Two luminous meteors of great magnitude were observed at Leipsic within the space of six years. On the 22d of May, 1680, about three in the morning, the first of these was seen to the great terror of the spectators, descending in the north, and leaving behind it a long white streak where it had passed. As the same phenomena was witnessed in the north-north-east at Haarburg, and also at Hamburgh, Lubec, and Stralsund, all of which places are about a hundred and fifty English miles from Leipsic, it was concluded that this meteor was exceedingly high above the earth. The second meteor was still more terrific. On the 9th of July, 1686, at half past one in the morning, a fire-ball with a tail was observed in 8½ degrees of Aquarius, and 4 degrees north, which continued nearly stationary for seven or eight minutes, with a diameter nearly equal to half the moon's diameter. At first, its light was so great that the spectators could see to read by it; after which it gradually disappeared. This phenomenon was observed at the same time in several other places, more especially at Schlaitza, a town distant from Dantzic forty English miles towards the south, its altitude being about 6° above the southern horizon. At Leipsic it was estimated to be distant not more than sixty English miles, and to be about twenty-four miles perpendicular above the horizon, so that it was at least thirty miles high in the air.

A very extraordinary meteor, which the common people called a flaming sword, was first seen at Leeds, in Yorkshire, on the 18th of May, 1710, at a quarter after ten at night. Its direction was from south to north: it was broad at one end, and small at the other; and was described by the spectators as resembling a trumpet, moving with the broad end foremost. The light was so sudden and bright, that they were startled at seeing their own shadows, when

neither sun nor moon shone upon them. This meteor was, in its course, seen, not only in Yorkshire and Lancashire, but also in the counties of Nottingham and Derby, notwithstanding which, each of these who observed it, although so many miles distant from each other, fancied it fell within a few yards of him. In disappearing, it presented bright sparklings at the small end.

A blazing meteor was, on the 19th of March, 1719, seen in every part of England. In the metropolis, about a quarter after eight at night, a sudden powerful light was perceived in the west, far exceeding that of the moon, which then shone very bright. The long stream it gave out appeared to be branched about the middle; and the meteor, in its course turned pear-fashioned, or tapering upwards. At the lower end it came at length to be larger and spherical, although not so large as the full moon. Its colour was whitish, with an eye of blue of a most vivid dazzling lustre, which seemed in brightness very nearly to resemble, if not to surpass, that of the body of the sun in a clear day. This brightness obliged the spectator to turn his eyes several times from it, as well when it was a stream, as when it was pear-fashioned and a globe. It seemed to move, in about half a minute or less, about the length of twenty degrees, and to disappear about as much above the horizon. Where it had passed, it left behind a track of a cloudy or faint reddish yellow colour, such as red-hot iron or glowing coals have: this continued more than a minute, seemed to sparkle, and kept its place without falling. This track was interrupted, or had a chasm towards its upper end, at about two-thirds of its length. Not any explosion was heard; but the place where the globe of light had been, continued for some time after it was extinct, of the same reddish yellow colour with the stream, and at first sparks seemed to issue from it, such as proceed from red hot iron beat out on an anvil.

It was agreed by all the spectators in the capital, that the splendour of this meteor was little inferior to that of the sun. Within doors the candles did not give out any light; and in the streets, not only all the stars disappeared, but the moon, then nine days old, and high near the meridian, the sky being very clear, was so far effaced as scarcely to be seen: it did not even cast a shade, where the beams of the meteor were intercepted by the houses; so that, for a

few seconds of time, there was in every respect a resemblance of perfect day.

The perpendicular height of this surprising meteor was estimated at 64 geometrical miles; and it was computed to have run about 300 of these miles in a minute. It was seen, not only in every part of Great Britain and Ireland, but likewise in Holland, in the hither parts of Germany, in France, and in Spain, nearly at the same instant of time. The accounts from Devonshire, Cornwall, and the neighbouring counties, were unanimous in describing the wonderful noise, which followed its explosion. It resembled the report of a large cannon, or rather of a broadside, at some distance, which was soon followed by a rattling noise, as if many small-arms had been promiscuously discharged. This tremendous sound was attended by an uncommon tremour of the air; and every where in those counties, not only the windows and doors of the houses were sensibly shaken, but, according to several of the reports, even the houses themselves, beyond the usual effect of cannon, however near.

On the 11th of December, 1741, at seven minutes past one in the afternoon, a globe of fire, somewhat larger than the horizontal full moon, and as bright as the moon appears at any time when the sun is above the horizon, was seen at Peckham, in Surry, in a south-south-east direction, moving towards the east with a continued equable motion, and leaving behind it a narrow streak of light, whiter than the globe itself, throughout its whole course. Towards the end it appeared less than at the beginning of its motion; and within three or four seconds suddenly vanished. Its apparent velocity was nearly equal to half the medium velocity of the ordinary meteors called falling or shooting stars; and its elevation, throughout the whole of its course, about twenty degrees above the horizon.

On the 18th of August, 1783, an uncommon meteor was seen in several parts of Great Britain, as well as on the continent. Its general appearance was that of a luminous ball, which, rising in the north-north-east, nearly of a globular form, became elliptical, and gradually assumed a tail as it ascended. In a certain part of its course it underwent a remarkable change, which might be compared to bursting, and which, it ought to be observed, has been since

frequently noticed in the passage of the aerolites, or meteoric stones, particular mention of which will be made hereafter. After this it no longer proceeded as an entire mass, but was apparently divided into a great number, or cluster of balls, some larger than others, and all carrying a tail, or leaving a train behind. Under this form, it continued its course with a nearly equable motion, dropping, or casting off sparks, and yielding a prodigious light, which illumined all objects to a surprising degree; until, having passed the east, and verging considerably to the southward, it gradually distended, and was at length lost to the sight. The time of its appearance was 9h. 16m. P. M. mean time of the meridian of London, and it continued visible about half a minute.

This beautiful meteor having been seen in Shetland, and in the northern parts of Scotland, ascending from the north, and rising like the planet Mars, little doubt was entertained of its course having commenced beyond the farthest extremity of this island, somewhere over the northern ocean. Having proceeded over Essex, and the Straits of Dover, it probably entered the continent not far from Dunkirk, where, as well as at Calais and Ostend, it was thought to be vertical. Still holding on its course to the southward, it was seen at Brussels, at Paris, and at Nuits in Burgundy; insomuch that there was sufficient proof of its having traversed thirteen or fourteen degrees of latitude, describing a track of at least one thousand miles over the surface of the earth;—a length of course far exceeding the extent of what had been then ascertained of any similar phenomenon.

During the passage of this meteor over Brussels, the moon appeared quite red, but soon recovered its natural light. The results of several observations give it an elevation of more than fifty miles above the surface of the earth, in a region where the air is at least thirty thousand times rarer than here below. Notwithstanding this great elevation, the fact of a report having been heard some time after it disappeared, rests on the testimony of too many witnesses to be controverted. It was compared to the falling of some heavy body in a room above stairs, or to the discharge of one or more large cannon at a distance: this report was loudest in Lincolnshire, and the adjacent counties, and also in the eastern parts of Kent.

Supposing the transverse diameter of this meteor to have subtended an angle of 30 minutes when it passed over the zenith, and that it was fifty miles high, it must have been almost half a mile across. The tail sometimes appeared ten or twelve times longer than the body; but most of this was train, and the real elongation behind seems seldom to have exceeded twice or thrice its tranverse diameter; it consequently was between one and two miles in length. Now, if the cubical contents be considered, for it appeared equally round and full in all directions, such an enormous mass must afford just matter of astonishment, when the extreme velocity with which it moved is considered. This velocity agreeably to the observations of Sir W. Herschel and several other astronomers, could not have been less than 20 miles in a second, exceeding that of sound above ninety times, and approaching toward that of the earth in her annual orbit. At such a rate it must have passed over the whole island of Great Britain in less than half a minute, and would, in the space of less than seven minutes, have traversed the whole diameter of the earth!

On the 4th of October of the above year, 1783, two meteors were seen in England. The first, at three in the morning, on account of the early hour, was witnessed by but few spectators, who represented it as rising from the north to a small altitude, and then becoming stationary with a vibratory motion, and an illumination like day-light: it vanished in a few moments, leaving a train behind. This sort of tremulous appearance has been noticed in other meteors, as well as their continuing stationary for some time, either before they begin to shoot, or after their course is ended. The second of these meteors appeared at forty-three minutes past six in the evening, and was much smaller, and also of much shorter duration, than the one seen in August. It was first observed to the north, like a stream of fire, similar to that of the common shooting stars, but large; and having proceeded some distance under this form, suddenly burst out into that intensely bright blueish light, peculiar to such meteors, which may be most aptly compared to the blue lights of India, or to some of the largest electrical sparks. The illumination was very great; and on that part of its course where it had been so bright, a dusky red streak or train was left, which remained

visible about a minute, and was thought by some gradually to change its form. Except this train, the meteor had not any tail, but was nearly of a round body, or, perhaps, somewhat elliptical. After moving not less than ten degrees in this bright state, it became suddenly extinct, without any appearance of bursting or explosion.

AEROLITES.

[*See Plate, No.* 52.]

THESE phenomena, otherwise entitled meteoric stones, have been ascertained, by recent observations, to be connected with the BOLIDES, or fire-balls, described above. Scoriaceous masses have frequently been either actually seen to fall at the time of the disappearance of the latter, or have been found soon after on the surface of the earth. Most of the stones which have fallen from the atmosphere have been preceded by the appearance of luminous bodies, or meteors. These meteors burst with an explosion, and then the shower of stones falls to the earth. Sometimes the stones continue luminous till they sink into the earth; but most commonly their luminousness disappears at the time of their explosion. These meteors move in a direction nearly horizontal, and seem to approach the earth before they explode.

The stony bodies, when found immediately after their descent, are always hot. They commonly bury themselves some depth under ground. Their size differs, from fragments of a very inconsiderable weight, to masses of several tons. They usually approach the spherical form, and are always covered with a black crust; in many cases they smell strongly of sulphur. The black crust consists chiefly of oxide of iron; and from several accurate analyses of these stones, the following important inferences have been drawn: that not any other bodies have as yet been discovered on our globe which contain the same ingredients; and that they have made us acquainted with a species of pyrites not formerly known, nor any where else to be found.

The ancients were not unacquainted with these meteoric stones, a shower of which is reported by Livy to have fallen at Rome under the Consulate of Tullus Hostilius, and another under that of C. Martius and M. Torquatus. Pliny

relates that a shower of iron (for thus he designates these stones) fell in Lucania, a year before the defeat of Crassus, and likewise speaks of a very large stone which fell near the river Negos, in Thrace. In the chronicle of Count Marcellin, there is an account of three immensely large stones having fallen in Thrace, in the year 452 before the Christian era. To proceed to more modern, and well authenticated instances of the fall of aerolites.

On the 7th of November, 1492, a little before noon, a dreadful thunder-clap was heard at Ensisheim, in Alsace, instantly after which a child saw a huge stone fall on a field newly sown with wheat. On searching, it was found to have penetrated the earth about three feet, and weighed 260lbs, making its size equal to a cube of thirteen inches the side. All the contemporary writers agree in the reality of this phenomenon, observing that, if such a stone had before existed in a ploughed land, it must have been known to the proprietor.

The celebrated astronomer Gassedi relates an instance of an aerolite descent of which he was himself an eye witness. On the 27th of November, 1627, the sky being clear, he saw a burning stone fall on Mont Vasir, in the south-east extremity of France, near Nice. While in the air, it seemed to be about four feet in diameter; was inclosed in a luminous circle of colours like a rainbow; and in its fall produced a sound like the discharge of cannon. It weighed 59lbs. was very hard, of a dull metallic colour, and had a specific gravity considerably greater than that of marble.

In the year 1672, two stones fell near Verona, in Italy, the one weighing 300, the other 200lbs. This phenomenon was witnessed in the evening, by three or four hundred persons. The stones fell, with a violent explosion, in a sloping direction, and in calm weather. They appeared to burn, and ploughed up the ground.

Paul Lucas, the traveller, relates that when he was at Larissa, a town of Greece, near the gulf of Salonica, a stone weighing 72lbs. fell in the vicinity. It was observed to come from the northward, with a loud hissing noise, and seemed to be enveloped in a small cloud, which exploded when the stone fell. It looked like iron dross, and smelt of sulphur.

In September 1753, several stones fell in the province

of Bresse, to the west of Geneva: one in particular fell at Pont-de-Vesle, and another at Liponas, places nine miles distant from each other. The sky was clear, and the weather warm. A loud noise, and a hissing sound, were heard at those two places, and for several miles round, on the fall of these stones, which exactly resembled each other, were of a darkish dull colour, very ponderous, and manifesting on their surface that they had suffered a violent degree of heat. The largest weighed about 20lbs. and penetrated about six inches into the ploughed ground; a circumstance which renders it highly improbable that they could have existed there before the explosion. This phenomenon has been described by the astronomer Delalande, whose strict enquiries on the spot enabled him to testify the truth of the circumstances he relates.

In the year 1768, three stones were presented to the French Academy of Sciences, which had fallen in different parts of France; one at Luce, in the Maine; another at Aire, in Artois; and the third in Cotentin. They were all externally of the same identical appearance; and on the former of them a particular report was drawn up by Messrs. Fougeraux, Cadet, and Lavoisier. This report states, that on the 18th of September, 1768, between four and five in the afternoon, there was seen, near the above village of Luce, a cloud in which a short explosion took place, followed by a hissing noise, but without any flame. The same sound was heard by several persons about ten miles from Luce; and, on looking up, they perceived an opaque body describe a curve in the air, and fall on a piece of green turf near the high road. They immediately ran to the spot, where they found a kind of stone, half buried in the earth, extremely hot, and weighing about 7½lbs.

In the particular instance now to be cited, very distinct traces were left to shew the progress of aerolites through the air. During the explosion of a meteor near Bordeaux, on the 20th of August, 1789, a stone in diameter about fifteen inches, fell through the roof of a cottage, and killed a herdsman and some cattle. Part of this stone is now in the Greville Museum, and part in the Museum of Bordeaux.

On the 24th of July, 1790, between nine and ten at night, a shower of stones fell near Agen, in Guienne, near the south-west angle of France. First a luminous ball of fire

was seen traversing the atmosphere with great rapidity, and leaving behind it a train of light which lasted about fifty seconds; soon after this a loud explosion was heard, and sparks were seen to fly off in all directions. This was soon after followed by the fall of stones, over a considerable extent of ground, and at various distances from each other. These were all alike in appearance, but of many different sizes, the greater number weighing about two ounces, but many a vast deal more. Some fell with a hissing noise, and entered the ground; but the smaller ones remained on the surface. The only damage done by this shower of stones was, that they broke the tiles of several houses, in falling on which they had not the sound of hard and compact substances, but of a matter in a soft half-melted state. Such as fell on straws adhered to them, and could not be readily separated;—a manifest proof that they were in a state of fusion.

On the 18th of December, 1795, several persons, near the house of Captain Topham, in Yorkshire, heard a loud noise in the air, followed by a hissing sound, and soon after felt a shock, as if a heavy body had fallen to the ground at a little distance from them. In reality, one of them saw a huge stone fall to the earth, at the distance of eight or nine yards from the place where he stood. When he first observed it, it was seven or eight yards above the ground; and in its fall it threw up the mould on every side, burying itself twenty-one inches in the earth. This stone on being dug up, was found to weigh 56lbs.

On the 17th of March, 1798, a body, burning with an intense light, passed over the vicinity of Ville Franche, on the Saone, near Lyons, accompanied by a hissing sound, and leaving behind a luminous track. This phenomenon exploded with a great noise, about twelve hundred feet from the ground, and one of the splinters, still luminous, having been observed to fall in a neighbouring vineyard, was traced. It was about a foot in diameter, and had penetrated twenty inches into the ground.

On the 4th of July, 1803, a ball of fire struck a public house at East Norton, in Oxfordshire. The chimney was thrown down, the roof partly torn off, the windows shattered to atoms, and the dairy &c. converted into a heap of rubbish. It was of considerable magnitude, and, on coming

in contact with the house, exploded with great noise, and a very oppressive sulphureous smell. Several fragments of stones were found on the spot, having a surface of a dark colour, and varnished as if in a state of fusion, with numerous globules of a whitish metal, combining sulphur and nickel. The indentures on these surfaces render it probable that the ball was soft when it descended; and it was obviously in a state of fusion, as the grass, &c. were burnt where the fragments fell. The motion of the fire-ball, while in the air, was very rapid, and apparently parallel to the horizon.

The latest remarkable fall of aerolites in Europe, of which there is a distinct account, was in the vicinity of Laigle in Normandy, early in the afternoon of the 26th of April, 1812. A fiery globe of a very brilliant splendour, which moved in the air with great rapidity, was followed in a few seconds by a violent explosion, which lasted five or six minutes, and was heard to the extent of more than thirty leagues in every direction. Three or four reports, like those of a cannon, were followed by a discharge resembling a fire of musquetry, after which a dreadful rumbling was heard, like the beating of a drum. The air was calm, and the sky serene, with the exception of a few clouds, such as are frequently observed. The noise proceeded from a small cloud of a rectangular form, the largest side being in a direction from east to west. It appeared motionless all the time the phenomenon lasted; but the vapour of which it was composed was projected momentarily from the different sides by the effect of the successive explosions. This cloud was about half a league to the north-north-east of the town of Laigle, and was at so great an elevation, that the inhabitants of two hamlets, a league distant from each other, saw it at the same time over their heads. In the whole canton over which this cloud hovered, a hissing noise, like that of a stone discharged from a sling, was heard; and a multitude of meteoric stones were seen to fall at the same time.

The district in which they fell forms an elliptical extent of about two leagues and a half in length, and nearly one in breadth; the greatest dimension being in a direction from south-east to north-west, forming a declination of about 22°. This direction, which the meteor must have followed, is exactly that of the magnetic meridian; which is a remark-

able result. The number of these stones was reckoned to exceed three thousand; and the largest of them weighed nearly 20lbs. They were friable some days after their fall, and smelt strongly of sulphur. They subsequently acquired the degree of hardness common to these stones.

While, in Europe, these phenomena thus strongly confirmed the long-exploded idea of the vulgar, that many of the luminous meteors observed in the atmosphere, are masses of ignited matter, an account of one of precisely the same description was received from the East Indies. On the 19th of December, 1798, at eight in the evening, a large fire-ball, or luminous meteor, was seen at Benares, and at several places in its vicinity. It was attended by a loud rumbling noise; and, about the same time, the inhabitants of Krakhut, fourteen miles from Benares, saw the light, heard what resembled a loud thunder-clap, and, immediately after, the noise of heavy bodies falling around them. Next morning the mould in the fields was found to have been turned up in many spots; and unusual stones of various sizes, but of the same substances, were picked out of the moist soil, generally from a depth of six inches. One stone fell through the roof of a hut, and buried itself in the earthern floor.

From these multiplied evidences it is proved that, in various parts of the world, luminous meteors have been seen moving through the air with surprising rapidity, in a direction more or less oblique, accompanied with a noise, commonly like the whizzing of cannon balls, followed by explosion, and the fall of hard, stony, or semi-metallic masses in a heated state. The constant whizzing sound; the fact of stones being found, similar to each other, but unlike all others in the vicinity, at the spots towards which the luminous body, or its fragments had been seen to move; the scattering or ploughing up of the soil at those spots, always in proportion to the size of the stones; the concussion of the neighbouring ground at the same time; and especially, the impinging of the stones on bodies somewhat above the earth, or lying loose on its surface, are circumstances perfectly well authenticated in these reports; proving that such meteors are usually inflamed hard masses, descending rapidly through the air to the earth.

AURORA BOREALIS, AND AURORA AUSTRALIS.

These splendid meteors are generally considered as the result of a combination of the two powers of magnetism and electricity. When the *light*, or *aurora*, appears chiefly in the north part of the heavens, it is called the AURORA BOREALIS, OF NORTHERN LIGHTS; and when chiefly in the south part, the AURORA AUSTRALIS, OF SOUTHERN LIGHTS. Where the coruscation is more than ordinarily bright and streaming, which, however, seldom occurs in the north, it is denominated LUMEN BOREALE; and where these streams have assumed a decided curvature, like that of the rainbow, they are distinguished by the name of LUMINOUS ARCHES.

The aurora is chiefly visible in the winter season, and in cold weather. It is usually of a reddish colour, inclining to yellow, and sends out frequent coruscations of pale light, which seem to rise from the horizon in a pyramidal, undulating form, shooting with great velocity up to the zenith. This meteor never appears near the equator; but of late years has frequently been seen towards the south pole.

The aurora borealis has appeared at some periods more frequently than at others. This phenomenon was so rare in England, or so little regarded, that its appearance was not recorded in our annals between a remarkable one observed on the 14th of November, 1554, and a very brilliant one on the 6th of March, 1716, and the two succeeding nights, but which was much strongest on the first night. Hence it may be inferred, that the state of either the air or earth, or perhaps of both, is not at all times fitted for its production.

The extent of these appearences is surprisingly great. The very brilliant one referred to above was visible from the west of Ireland to the confines of Russia, and the east of Poland, extending over, at the least, thirty degrees of longitude, and, from about the fiftieth degree of latitude, over almost all the northern part of Europe. In every place, it exhibited, at the same time, the same wonderful features. The elevation of these lights is equally surprising: an aurora borealis which appeared on the 16th of

December, 1737, was ascertained, by a mean of thirty computations, to have an average height from the earth of 175 leagues, equal to 464 English miles.

Captain Cook, in his first voyage round the world, observes that these coruscations are frequently visible in southern latitudes. On the 16th of September, 1770, he witnessed an appearance of this kind about 10 at night, consisting of a dull, reddish light, and extending about twenty degrees above the horizon. Its extent was very different at different times, but it was never less than eight or ten points of the compass. Rays of light, of a brighter colour, passed through and without it; and these rays vanished and were renewed nearly in the same time as those in the aurora borealis, but had little or no vibration. Its body bore S. S. E. from the ship, and continued, without any diminution of its brightness, till twelve o'clock, when the observers retired. The ship was at this time within the tropic of capricorn.

On the 17th of February, 1773, during his second voyage, Captain Cook speaks of a beautiful phenomenon that was observed in the heavens. "It consisted of long columns of a clear white light, shooting up from the horizon to the eastward, almost to the zenith, and spreading gradually over the whole southern parts of the sky. These columns even sometimes bent sideways at their upper extremity; and, although in most respects similar to the northern lights, (the *aurora borealis* of our hemisphere) yet differed from them in being always of a whitish colour; whereas ours assume various tints, especially those of a fiery and purple hue. The stars were sometimes hidden by, and sometimes faintly to be seen through the substance of these southern lights, *aurora australis*. The sky was generally clear when they appeared, and the air sharp and cold, the mercury in the thermometer standing at the freezing point; the ship being then in 58 degrees south." On six different nights of the following month (March) the same phenomenon was observed.

LUMEN BOREALE, OR STREAMING LIGHTS.

On the 8th of October, 1726, uncommon streams of light were exhibited in every part of the heavens, about eight o'clock in the evening. They were seen throughout Eng-

land, as well as in the southern parts of Europe. They were mostly pointed, and of different lengths, assuming the appearance of flaming sphires or pyramids; some again were truncated, and reached but half way; while others had their points reaching up to the zenith, or near it, where they formed a sort of canopy, or thin cloud, sometimes red, sometimes brownish, sometimes blazing as if on fire, and sometimes emitting streams all around it. This canopy was manifestly formed by the matter carried up by the streaming on all parts of the horizon. It sometimes seemed to ascend with a force, as if impelled by the impetus of some explosive agent below; and this forcible ascent of the streaming matter gave a motion to the canopy, and sometimes a gyration, like that of a whirlwind. This was manifestly caused by the streams striking the outer part of the canopy; but if they struck the canopy in the centre, all was then confusion. The vapours between the spires, or pyramids, were of a blood-red colour, which gave those parts of the atmosphere the appearance of blazing lances, and bloody-coloured pillars. There was also a strange commotion among the streams, as if some large cloud or other body was moving behind and disturbing them. In the northern and southern parts the streams were perpendicular to the horizon; but in the intermediate points they seemed to decline more or less in one way or the other; or rather to incline towards the meridian. Several persons declared that, in the time of the streaming, they heard a hissing, and in some places a crackling noise, like what is reported to be often heard in earthquakes.

At Naples, on the 16th of December, 1737, early in the evening, a light was observed in the north, as if the air was on fire, and flashing. Its intenseness gradually increasing, about seven o'clock it spread to the westward. Its greatest height was about 65 degrees. Its extremities were unequally jagged and scattered, and followed the course of the westerly wind; so that for a few hours it spread considerably wider, yet without ever reaching the zenith. About eight o'clock, a very regular arch, of a parabolic figure, was seen to rise gently, to two degrees of rectangular elevation, and to twenty degrees of horizontal amplitude. At ten the intenseness of the colour disappeared; and by midnight not any traces of this phenome-

non were left. It was seen throughout Italy, as the subsequent accounts will show.

At Padua, on the appearance of this extraordinary meteor, the air was calm, and the barometer remarkably high. At five in the afternoon a blackish zone, with its upper limb of a sky-colour, appeared near the horizon: and above this zone was another, very luminous, resembling the dawn pretty far advanced. The highest zone was of a red fiery colour. A little after six o'clock, the upper parts of these zones emitted an abundance of red streamings, or rays; their vivid colour being occasionally intermixed with whitish and dark spots. In a few seconds after, there issued from the west, a red and very bright column, which ascended to the third part of the heavens, and which, a little after became curved like a rainbow. At half past eight, almost instantaneously, the bright zone, from eight degrees west to fifty degrees east, became more vivid, and rose higher; and above this appeared a new large one, of a red fiery colour, with several successive streamings tending upward, and exceeding sixty degrees of altitude; the western part having assumed the form of a thin cloud.—At midnight these splendid lights disappeared entirely.

At Bononia, this surprising meteor spread to such an extent as to occupy about one hundred and forty degrees of the heavens. Its light was so vivid that houses could be distinguished, at eight in the evening, at a very considerable distance; and these were so reddened, that many persons thought there was a fire in the neighbourhood. At that time the aurora formed itself into a concave arch towards the horizon; and in half an hour, at its eastern limit, a pyramid was displayed, of a more intense colour towards the north, from the centre of which there shot up vertically a streak of light, between a white and a yellow colour.—A very dark narrow cloud crossed the whole phenomenon, and went to terminate in the pyramid. At the upper part, a very considerable tract of the heavens was enlightened by a very vivid red light, which was interrupted by several streaks or columns of a bright yellowish light. These streamings shot up vertically, and parallel to each other, the narrow cloud seeming to serve them as a basis. Under the cloud there issued forth two tails of a whitish light, hanging downward on a basis of a weak red, and seeming

to kindle and dart the light downward. A white streak, which passed across these two tails, and extended from one end of the phenomenon to the other, in a position almost parallel to the above-mentioned cloud, gave a splendid effect to the whole. This surprising meteor disappeared a little after nine o'clock; but an abundance of falling stars were afterward seen in the south.

Similar observations were made at Rome; but in Great Britain, where this phenomenon was likewise seen, different appearances were displayed. At Edinburgh, at six in the evening, the sky appeared to be in flames. An arch of red light reached from the west, over the zenith, to the east, its northern border being tinged with a colour approaching to blue. This aurora did not first form in the north, as usually happens, and after forming an arch there, rise toward the zenith; neither did the light shiver, and spread itself, by sudden jerks, over the hemisphere, as is common; but gradually and gently stole along the face of the heavens, tlll it had covered the whole hemisphere: this alarmed the vulgar, and was indeed a strange sight. At Rosehill, in Sussex, it appeared as a strong and very steady light, nearly of the colour of red ochre. It did not dart or flash, but kept a steady course against the wind, which blew fresh from the south-west. It began in the north-north-west, in form of a pillar of light, at a quarter past six in the evening: in about ten minutes a fourth part of it divided from the rest, and never joined again. In ten minutes more it described an arch, but did not join at top; and at seven o'clock it formed a bow, disappearing soon after. It was lightest and reddest at the horizon, and gave as much light as a full moon.

LUMINOUS ARCHES.

In the month of March, 1774, a very beautiful luminous arch was seen at Buxton. It was white, inclining to yellow: and its breadth in the crown was apparently equal to that of the rainbow. As it approached the horizon, each leg of the arch became gradually broader. It was stationary and free from any sensible coruscations. Its direction was from north-east to south-west; and its crown or most

elevated part, not far from the zenith. This phenomenon lasted about half an hour.

The grandest spectacle of this kind which appears to have been seen in Great Britain, was observed at Leeds, in Yorkshire, on the 12th of April, 1783, between the hours of nine and ten at night. A broad arch of a bright pale yellow, and having an apparent breadth of about fifteen degrees, arose in the heavens, and passed considerably south of the zenith. Such was its varied density, that it appeared to consist of small columns of light, having a sensible motion. After about ten minutes innumerable bright coruscations shot out at right angles from its northern edge, elongating themselves more and more till they had nearly reached the northern horizon. As they descended, their extremities were tipped with an elegant crimson, such as is produced by the electric spark in an exhausted tube. After some time this beautiful northern light ceased to shoot, and, forming a range of bright yellow clouds, which extended horizontally about the fourth of a circle, its greatest portion, which darted from this arch towards the north, as well as the cloud-like and more stationary aurora, became so dense as to hide the stars from view. The moon was eleven days old, and shone brightly during this scene, but did not eclipse the splendour of these coruscations. The wind was in the north, a little inclined to the east.

A similar phenomenon was observed at Leeds on the 26th of the same month. From a mass, or broad column of light in the west, issued three luminous arches, each of which made a different angle with the horizon. They had not been viewed many minutes when they were rendered invisible by a general blaze of aurora borealis, which possessed the space just before occupied by these arches.

IGNEUS FATUI, OR MOCK-FIRES.

These meteors, denominated by the vulgar *Will-with-a-wisp*, and *Jack-with-a-lanthorn;* and, at sea, or on the coast, *Mariners' lights*, or *St. Helmo's fires*, are now considered as real exhalations from the earth, produced by gas, vapour, or some other attenuated substance, emanating from vegetable, animal, or mineral materials, and com-

bined with the matter of light or heat, or both. Instead of being dense or solid, they are uniformly rare and subtile; and, instead of originating in the loftiest regions of the atmosphere, or beyond its range, are generated for the greater part in low marshy plains or valleys. To the fearful and superstitious they are a source of as much terror as the nobler and sublimer meteors which have just been contemplated; and it is probable that they have occasionally been the source of real and extensive damage, when in a state of actual combustion; and that they have still more frequently seduced a timid and benighted traveller into dangerous bogs and quagmires.

In Italy, in the Bolognese territory, they are so frequent, in the morassy grounds, that they are to be seen every night, some of them affording as much light as a kindled torch, and others not being larger than the flame of a candle, but all of them so luminous as to shed a lustre on the surrounding objects. They are constantly in motion, but this motion is various and uncertain. They sometimes rise and at other times sink, occasionally disappearing of a sudden, and appearing again in an instant in some other place. They usually hover about six feet from the ground, differing both in figure and size, and spreading out and contracting themselves alternately. Sometimes they break to appearance into two parts, soon after uniting again in one body; and at intervals float like waves, letting fall portions of ignited matter, like sparks from a fire. They are more frequently observed in winter than in summer, and cast the strongest light in rainy and moist weather.— They are most friendly to the banks of brooks and rivers, and to morasses; but are likewise seen on elevated grounds, where they are, however, of a comparatively diminutive size.

In the month of March, 1728, a traveller being in a mountainous road, about ten miles south of Bononia, perceived, as he approached the river Riovedere, between eight and nine in the evening, a light shining very brightly on some stones which lay on the banks. It was elevated about two feet above them; its figure describing a parallelopid, more than a foot in length, and about six inches high, its longest side lying parallel to the horizon. Its light was so strong that he could distinguish by it very plainly a part of a neighbouring hedge, and the

water in the river. On a near approach, it changed from a bright red to a yellowish colour; and on drawing still nearer became pale; but when the observer reached the spot, it vanished. On his stepping back, he not only saw it again, but found that the farther he receded, the stronger and more luminous it became. This light was afterwards seen several times, both in Spring and Autumn, precisely at the same spot, and preserving the same shape.

On the 12th of December, 1776, several very remarkable *ignes fatui* were observed on the road to Bromsgrove, five miles from Birmingham, a little before daylight. A great many of these lights were playing in an adjacent field, in different directions; from some of which there suddenly sprang up bright branches of light, something resembling the explosion of a rocket, filled with many brilliant stars, if, in the case of the latter, the discharge be supposed to be upward, or vertical, instead of taking the usual direction. The hedge, and the trees on each side, were strongly illuminated. This appearance continued a few seconds only, when the *ignes fatui* played as before. The spectator was not sufficiently near to observe whether the apparent explosions were attended with any report.

In the month of December, 1693, between the 24th and 30th, a fiery exhalation, without doubt generated in the same way with the meteors described above, set fire to sixteen ricks of hay, and two barns filled with corn and hay, at a village of Hartech, in Pembrokeshire. It had frequently been seen before, proceeding from the sea, and in these instances lasted for a fortnight or three weeks. It not only fired the hay, but poisoned the grass, for the extent of a mile, so as to induce a distemper among the cattle. It was a weak blue flame, easily extinguished, and did not in the least burn any of the men who interposed their endeavours to save the hay, although they ventured, not only close to it, but sometimes into it. All the damage sustained happened constantly in the night.

Belonging to this class of meteors is the DRACO VOLANS, a fiery exhalation, frequent in marshy and cold countries. It is most common in summer: and, although principally seen playing near the banks of rivers, or in boggy places, still it sometimes mounts up to a considerable height in the air, to the no small terror of the amazed beholders. Its

appearance is that of an oblong, sometimes roundish, fiery body, with a long tail. It is entirely harmless, frequently sticking to the hands and clothes of the spectators, without doing them the least injury.

SPECTRE OF THE BROKEN.

This is one of those curious and interesting atmospherical phenomena, or deceptions, which proceed from one common cause, an irregularity in the tenuity of the atmospheric fluid. This fluid is commonly of an homogeneous, or equable tenuity, and consequently suffers the rays of the sun to penetrate it without any obstruction or change; but is at times irregular, and composed of parts of bodies of a denser medium than its general texture and constitution. Under these circumstances, the fluent ray, if it do not enter the denser medium in a direct or perpendicular line, will be either reflected, or refracted, or both; and the object surveyed through it, will assume a new, and, not unfrequently, a grotesque or highly magnified appearance.

The Spectre of the Broken is an aerial figure which is sometimes seen among the Hartz mountains in Hanover. This phenomenon has been witnessed by various travellers, and among them, by M. Haue, from whose relation the following particulars are extracted. "Having ascended the Broken (mountain) for the thirtieth time, I was at length so fortunate as to have the pleasure of seeing this phenomenon. The sun rose about four o'clock, and the atmosphere being quite serene towards the east, its rays could pass without any obstruction over the Heinrichshohe mountain. In the south-west, however, towards the mountain Achtermannshohe, a brisk west wind carried before it thin transparent vapours. About a quarter past four I looked round, to see whether the atmosphere would permit me to have a free prospect to the south-west, when I observed, at a very great distance towards the Achtermannshohe, a human figure of monstrous size! A violent gust of wind having almost carried away my hat, I clapped my hand to it; and in moving my hand towards my head, the colossal figure did the same.

"The pleasure which I felt at this discovery can hardly be described; for I had already walked many a weary

step in the hope of seeing this shadowy image, without being able to gratify my curiosity. I immediately made another movement, by bending my body, and the colossal figure before me repeated it. I was desirous of doing the same once more, but my colossus had vanished. I remained in the same position, waiting to see whether it would return; and in a few minutes it again made its appearance on the Achtermannshohe. I then called the landlord of the neighbouring inn, and having both taken the position which I had taken alone, we looked towards the Achtermannshohe, but did not perceive any thing. We had not, however, stood long, when two such colossal figures were formed over the above eminence, which repeated their compliments by bending their bodies as we did, after which they vanished. We retained our position, kept our eyes fixed on the spot, and in a little time the two figures again stood before us, and were joined by a third." [that of a traveller who then came up and joined the party.] "Every movement made by us, these figures imitated; but with this difference, that the phenomenon was sometimes weak and faint, sometimes strong and well defined."

In Clarke's "Survey of the Lakes," a phenomenon similar to that of the Spectre of the Broken, is recorded to have been observed in the years 1743, and 1744, on Souter Fell, a mountain in Cumberland. It excited much conversation and alarm at the time, and exposed to great ridicule those who asserted they had witnessed it. It is, however, too well attested not to deserve a short notice here, and may be referred to the same causes by which the above aerial images on the Broken mountain were produced.—The relation is as follows.

Souter Fell is a mountain about half a mile in height, inclosed on the north and west sides by precipitous rocks, but somewhat more open on the east, and easier of access. At Wilton Hall, within half a mile of this mountain, on a summer's evening, in the year 1743, a farmer and his servant, sitting at the door, saw the figure of a man with a dog, pursuing some horses along Souter Fell side, a place so steep that a horse could scarcely travel on it. They appeared to run at a very great pace, till they got out of sight at the lower end of the Fell. On the following morning the farmer and his servant ascended the steep side of the

mountain, in full expectation that they should find the man lying dead, being persuaded that the swiftness with which he ran must have killed him; and imagined also that they should pick up some of the shoes which they thought the horses must have lost, in galloping at so furious a rate. They were, however, disappointed, as not the least vestige of either man or horses appeared, not so much as the mark of a horse's hoof on the turf.

On the 23d of June of the following year, 1744, about half past seven in the evening, the same servant, then residing at Blakehills, at an equal distance from the mountain, being in a field in front of the farm-house, saw a troop of horsemen riding on Souter-Fell side in pretty close ranks, and at a brisk pace. Having observed them for some time he called out his young master, who before the spot was pointed out to him, discovered the aerial troopers; and this phenomenon was shortly after witnessed by the whole of the family. The visionary horsemen appeared to come from the lowest part of Souter-Fell, and were visible at a place called Knott: they then moved in regular troops along the side of the Fell, till they came opposite to Blakehills, when they went over the mountain. They thus described a kind of curvilinear path, and their first as well as their last appearance, was bounded by the foot of the mountain. Their pace was that of a regular swift walk; and they were seen for upwards of two hours, when darkness intervened. Several troops were seen in succession, and frequently the last, or last but one in the troop, would quit his position, gallop to the front, and then observe the same pace with the others. The same change was visible to all the spectators; and the sight of this phenomenon was not confined to Blakehills, but was witnessed by the inhabitants of the cottages within a mile. It was attested before a magistrate by the two above-cited individuals in the month of July, 1785. Twenty-six persons are said in the attestation to have witnessed the march of these aerial travellers.

It should be remarked that these appearances were observed on the eve of the rebellion, when troops of horsemen might be privately exercising; and as the imitative powers of the Spectre of the Broken demonstrate that the actions of human beings are sometimes pictured in the

clouds, it seems highly probable, on a consideration of all the circumstances of this latter phenomenon on Souter Fell, that certain thin vapours must have hovered round the summit of the mountain when the appearances were observed. It is also probable that these vapours may have been impressed with the shadowy forms which seemed to "imitate humanity," by a particular operation of the sun's rays, united with some singular, but unknown, refractive combinations then taking place in the atmosphere.

THE MIRAGE.

THIS very curious phenomenon, which was remarked by M. Monge, one of the French savans belonging to the Institute of Cairo, in the hot and sandy desert between Alexandria and that city, is described by him as resulting from an inverted image of the cerulian sky intermixed with the ground scenery, the neighbouring villages appearing to be surrounded with the most beautiful sheeting of water, and to exist, like islands, in its liquid expanse, tatalizing the eye by an unfaithful representation of what the thirsty traveller earnestly desires.

Doctor Clarke, in his interesting travels, introduces the following animated description of this phenomenon. "Here [at the village of Utko] we procured asses for our party, and, setting out for Rosetta, began to re-cross the desert, appearing like an ocean of sand, but flatter and firmer as to its surface, than before. The Arabs, uttering their harsh gutteral language, ran chattering by the side of our asses; until some of them calling out '*Raschid!*' we perceived its domes and turrets, apparently upon the opposite side of an immense lake or sea, that covered all the intervening space between us and the city. Not having in my own mind, at the time, any doubt as to the certainty of its being water, and seeing the tall minarets and buildings of Rosetta, with all its groves of dates and sycamores, as perfectly reflected by it as by a mirror, insomuch that even the minutest detail of the architecture, and of the trees, might have been thence delineated, I applied to the Arabs to be informed in what manner we were to pass the water. Our interpreter although a Greek, and therefore likely to have been informed of such a phenomenon, was

as fully convinced as any of us that we were drawing near to the water's edge, and became indignant, when the Arabs maintained, that within an hour we should reach Rosetta, by crossing the sands in the direct line we then pursued, and that there was no water, 'What,' said he, giving way to his impatience, 'do you suppose me an ideot, to be persuaded contrary to the evidence of my senses?' The Arabs, smiling, soon pacified him, and completely astonished the whole party, by desiring us to look back at the desert we had already passed, where we beheld a precisely similar appearance. It was, in fact, *the mirage*, a prodigy to which every one of us were then strangers, although it afterwards became more familiar. Yet upon no future occasion did we ever behold this extraordinary illusion so marvellously displayed. The view of it afforded us ideas of the horrible despondency to which travellers must sometimes be exposed, who, in traversing the interminable desert, destitute of water, and perishing with thirst, have sometimes this deceitful prospect before their eyes."

This appearance is often seen, when the sun shines, upon the extensive flat sand upon the shores of the Bristol channel, in Somersetshire, and probably on the sea-shore in other parts of England; the cause is, we believe, the evaporation of water.

FATA MORGANA.

As when a shepherd of the hebride isles
Placed far amid the melancholy main,
(Whether it be lone fancy him beguiles,
Or that aerial beings sometimes deign
To stand, embodied, to our senses plain)
Sees on the naked hill, or valley low,
The whilst in ocean Phœbus dips his wain,
A vast assemblage moving to and fro;
Then all at once in air dissolves the wondrous show.

THOMSON.

THESE optical appearances of figures in the sea and air, in the Faro of Messina, are the great delight of the populace, who, whenever the vision is displayed, run about the streets shouting for joy, and calling on every one to partake of the glorious sight. To produce this pleasing deception, many circumstances must concur which are not

known to exist in any other situation. The spectator must stand with his back to the east, in some elevated place behind the city, that he may command a view of the the whole bay, beyond which the mountains of Messina rise like a wall, and darken the back-ground of the picture. The winds must be hushed, the surface quite smoothed, the tide at its height, and the waters pressed up by currents to a great elevation in the middle of the channel. All these events coinciding, as soon as the sun surmounts the eastern hills behind Reggio, (on the Calabrian coast opposite) and rises high enough to form an angle of forty-five degrees on the water before the city, every object, existing or moving at Reggio, will be repeated a thousand-fold in this marine-looking glass, which, by its tremulous motion, is, as it were, cut into facets. Each image will pass rapidly off in succession, as the day advances, and the stream carries down the wave on which it appeared.—Thus the parts of this moving picture will vanish in the twinkling of an eye. Sometimes the air is at that time so impregnated with vapours, and undisturbed by winds, as to reflect objects in a kind of aerial screen, rising about thirty feet above the level of the sea. In cloudy, heavy weather, they are drawn on the surface of the water, bordered with fine prismatic colours.

Swinburne, in his travels, cites Father Angelucci as having been the first to describe this phenomenon accurately. His relation is as follows. "On the 15th of August, 1643, as I stood at my window, I was surprised with a most wonderful and delectable vision. The sea which washes the Sicilian shore swelled up, and became, for 12 miles in length, like a chain of dark mountains; while the waters near our Calabrian coast grew quite smooth, and in an instant appeared as one polished mirror, reclining against the aforesaid ridge. On this glass was depicted, in *chiar-oscura*, a string of several thousands of pilasters, all equal in altitude, distance, and degree of light and shade. In a moment they lost half their height, and bent into arcades, like Roman aqueducts. A long cornice was next formed on the top, and above it rose castles innumerable, all perfectly alike. These soon split into towers, which were shortly after lost in colonnades, then in windows, and at last ended in pines, cypresses, and other



trees, even and similar. This was the Fata Morgana, which, for twenty-six years, I had thought a mere fable."

ATMOSPHERICAL REFRACTION.

A SURPRISING instance of atmospherical refraction occurred at Hastings on the 26th of July, 1798. W. Latham, Esq. F. R. S. sitting in his dining room, situated on the parade, close to the sea-shore, and nearly fronting the south, about five in the afternoon, had his attention suddenly drawn by a great number of people running down to the sea-side. On enquiring the reason, he was informed that the coast of France was plainly to be distinguished by the naked eye. On going down to the shore, he was surprised to find that, even without the assistance of a telescope, he could very plainly see the cliffs on the opposite coast; which, at the nearest part, are between forty and fifty miles distant, and are not to be discerned, from that low situation, by the aid of the best glasses. They appeared to be only a few miles off, and seemed to extend for some leagues along the coast. Pursuing his walk along the shore to the eastward, close to the water's edge, and conversing on the subject with the sailors and fishermen, they could not, at first, be persuaded of the reality of the appearance; but soon became so thoroughly convinced, by the cliffs gradually appearing more elevated, and approaching nearer as it were, that they pointed out, and named to him the different places they had been accustomed to visit, such as, the Bay, the Old Head or Man, the Windmill, &c. at Boulogne; together with St. Vallery, and other places on the coast of Picardy. This they afterwards confirmed, when they viewed them, thus refracted, through their telescopes, observing that the above places appeared as near as if they had been sailing, at a small distance, into the harbours.

From the eastern cliff, which is of a very considerable height, a most beautiful scene presented itself to Mr. Latham's view, for there he could at once see Dungeness, Dover Cliffs, and the French coast, all along from Calais, Boulogne, &c. to St. Vallery; and, as some of the fishermen affirmed, as far to the westward even as Dieppe. By the telescope, the French fishing boats were plainly

to be seen at anchor, and the different colours of the land on the heights, with the buildings, were perfectly discernible. This curious phenomenon continued in the highest splendour till half past eight o'clock, notwithstanding a black cloud for some time totally obscured the face of the sun, and then vanished gradually. So remarkable an instance of atmospherical refraction had not been before witnessed by the oldest inhabitant of Hastings. It was likewise observed at Winchelsea, and other places along the coast. The day was remarkably hot, without a breath of wind stirring.

PARHELIA, OR MOCK SUNS.

On the 5th of February, 1674, near Marienberg in Prussia, the sky every where serene, the sun, which was still some degrees above the horizon, was seen to lance out very long and reddish rays, forty or fifty degrees towards the zenith, notwithstanding it shone with great lustre. Beneath this planet, towards the horizon, there hung a somewhat dilute small cloud, at the inferior part of which there appeared a mock sun, of the same apparent size with the true sun, and of a somewhat red colour. Soon after, the true sun descending gradually to the horizon, towards the said cloud, the spurious sun beneath it grew clearer and clearer, in so much that the reddish colour in this apparent solar disc vanished, and put on the genuine solar light, in proportion as it was approximated by the genuine disc of the sun. The latter, at length, passed into the lower counterfeit sun, and thus remained alone. This phenomenon was considered the more extraordinary, as it was perpendicular under the sun, instead of being at its side, as parhelia usually are; not to mention the colour, so different from that which is usual in mock suns, nor the great length of the tail, cast up by the genuine sun, of a far more vivid and splendid light than parhelia use to exhibit. This appearance was soon followed by an exceedingly intense frost, which lasted till the 25th of March, the whole bay being frozen up from the town of Dantzic to Hela in the Baltic Sea.

On the 28th of August, 1698, about eight o'clock in the morning, there was seen at Sudbury, in Suffolk, the ap-

pearance of three suns, which were then extremely brilliant. Beneath a dark, watery cloud, in the east, nearly at its centre, the true sun shone with such strong beams, that the spectators could not look at it; and on each side were the reflections. Much of the firmament was elsewhere of an azure colour. The circles were not coloured like the rainbow, but white; and there was also, at the same time, higher in the firmament, and towards the south, at a considerable distance from the other phenomena, the form of a half moon, but apparently of double the size, with the horns turned upward. This appearance was within of a fiery red colour, imitating that of the rainbow. These phenomena faded gradually, after having continued about two hours.

Two mock suns, an arc of a rainbow inverted, and a halo, were seen at Lyndon, in the county of Rutland, on the 22d of October, 1621, at eleven in the morning. There had been an aurora borealis the preceding night, with the wind at west-south-west. The two parhelia, or mock suns, were bright and distinct, and in the usual places, namely, in the two intersections of a strong and large portion of a halo, with an imaginary circle parallel to the horizon, passing through the true sun. Each parhelion had its tail of a white colour, and in direct opposition to the true sun; that towards the east being 20 degrees or 25 degrees long, and that towards the west 10° or 12°, both narrowest at the remote ends. The mock suns were evidently red towards the sun, but pale or whitish at the opposite sides, as was the halo also. Still higher in the heavens, was an arc of a curiously inverted rainbow, about the middle of the distance between the top of the halo and the vertex. This arc was as distinct in its colours as the common rainbow, and of the same breadth. The red colour was on the convex, and the blue on the concave of the arc, which seemed to be about 90° in length, its centre being in or near the vertex. On the top of the halo was a kind of inverted bright arc. This phenomenon was seen on the following day, and, again, on the 26th. On the 11th of the preceding month, September, a very splendid and remarkable aurora borealis, presenting truly unaccountable motions and removals, was witnessed at Rutlandshire, in Northhamptonshire, and at Bath.

LUNAR RAINBOW.

This very rare phenomenon was witnessed at Glapwell Hall, in Derbyshire, on the 25th of December, 1710, about eight in the evening, with a remarkable and very unusual display of colours. The moon had passed her full about twenty-four hours, and the evening had been rainy; but the clouds were dispersed, and the moon then shone pretty clear. This iris lunaris had all the colours of the solar iris, exceedingly beautiful and distinct, only faint in comparison with those which are seen in the day; as must necessarily have been the case, both from the different beams by which it was occasioned, and the disposition of the medium. What most surprised the observer was the largeness of the arc, which was not so much less than that of the sun, as the different dimensions of their bodies, and their respective distances from the earth, seemed to require; but the entireness and beauty of its colours furnished a charming spectacle.

CONCENTRIC RAINBOWS.

This extraordinary phenomenon, which is seen at sun-rise on the Cordilleras of the Andes, in South America, was first witnessed by Ulloa and his companions in the wild heaths of Pambamarca, and is thus described by him. "At day-break the whole of the mountain was enveloped "in dense clouds, which at sun-rise were dissipated, leav-"ing behind them vapours of so extreme a tenuity as not to "be distinguishable to the sight. At the side opposite to "that where the sun rose on the mountain, and at the dis-"tance of about sixty yards from the spot where we were "standing, the image of each of us was seen represented, "as if in a mirror, three concentric rainbows, the last, or "most exterior colours of one of which touched the first "of the following one, being centered on the head. With-"out the whole of them, and at an inconsiderable distance, "was seen a fourth arc purely white. They were all "perpendicular to the horizon; and in proportion as any "one of us moved from one side to the other, he was ac-"companied by the phenomenon, which preserved the

"same order and disposition. What was however, most "remarkable, was this, that although six or seven persons "were thus standing close together, each of us, saw the "phenomenon as it regarded himself, but did not perceive "it in the others. This, adds Bouguer, is a kind of apoth-"esis, in which each of the spectators, seeing his head "adorned with a glory formed of three or four concentric "crowns of a very vivid colour, each of them presenting "varieties similar to those of the first rainbow, tranquilly "enjoys the sensible pleasure of reflecting that the brilliant "garland he cannot discover in the others is destined for "himself alone."

A similar phenomenon is described by Mr. Hagarth, F. R. S. as having been seen by him on the 13th of February, 1780. His relation is as follows. "In ascending, at Rhealt, the mountain which forms the eastern boundary of the vale of Clwyd (in Denbighire) I observed a rare and curious phenomenon. In the road above me, I was struck with the peculiar appearance of a very white shining cloud, which lay remarkably close to the ground.— The sun was near setting, but shone extremely bright: I walked up to the cloud, and my shadow was projected into it, its superior part being surrounded, at some distance, by a circle of various colours, whose centre appeared to be near the situation of the eye, and whose circumference extended to the shoulders. This circle was complete, except what the shadow of my body intercepted. It exhibited the most vivid colours, the red being outermost, all of them appearing in the same order and proportion as they are presented to the view by the rainbow. It resembled very exactly what in pictures is termed A GLORY, surrounding the heads of saints: not indeed that it exhibited the luminous radiance that is painted close to the head, but an arch of concentric colours placed separately and distinctly from it. As I walked forward, this glory approached or retired, just as the inequality of the ground shortened or lengthened my shadow. The cloud being sometimes in a small valley below me, sometimes on the same level, or on higher ground, the variation of the shadow and glory became extremely striking and singular. To add to the beauty of the scene, there appeared, at a considerable distance, to the right and left, the arches of a white shining

bow. These arches were in the form of, and broader than a rainbow; but were not completely joined into a semicircle above, on account of the shallowness of the cloud."

THUNDER AND LIGHTNING.

The thunder of his power who can understand?

JOB.

Loud thunder, livid flames, and Stygian night,
Compounded horrors, all the deep affright.

BLACKMORE.

To conceive justly of the nature of thunder and lightning, we have only to view the effects of a common electrical machine, and its apparatus, in an apartment. These experiments mimic the great, wonderful, and terrific phenomena of nature. The stream, or spark, from the machine to the hand, represents the shaft of lightning from the clouds to the earth; and the snapping noise of the diminutive spark corresponds with the explosion produced by the shaft of lightning which we call thunder. In what manner the clouds become electrified, and, in short, what is the nature of electricity itself, our present range of experiments so little qualify us to determine, that a century will perhaps elapse before a philosophical precision can be attained.—At present we only know for certain that the electrical power displays itself merely on the surface of bodies; and whether it is a fluid *per se*, a vacuum restoring itself, or whatever its nature may be, the state of experimental knowledge does not enable us to determine.

The obvious analogy between lightning and electricity had long been suspected, and was placed beyond a doubt by Doctor Franklin, who was the first to conceive the practicability of drawing down lightning from the clouds.—Having found by previous experiments, that the electric fluid is attracted by points, he apprehended that lightning might likewise possess the same quality; although the effects of the latter would in that case surpass those of the former in an astonishing degree. Flashes of lightning, he likewise observed, are generally seen crooked and waving in the air; and the electric spark drawn from an irregular body at some distance, when it is drawn by an irregular body, or through a space in which the best conductors are

disposed in an irregular manner, always exhibits the same appearance.

Lightning strikes the highest and most pointed objects in its way, in preference to others, as high hills, trees, spires, masts, &c; and all pointed conductors receive and throw off the electric fluid more readily than those which are terminated by flat surfaces. Lightning is observed to take the best and readiest conductor; and this is also the case with electricity, in the discharge of the Leyden phial; whence Doctor Franklin inferred that, in a thunder-storm, it would be safer for a person to have his clothes wet than dry. Lightning burns, dissolves metals, rends some particular bodies, such as the roots and branches of trees, strikes persons with blindness, destroys animal life, deprives magnets of their virtue, and reverses their poles; and these are the well known properties of electricity.

Lightning not only gives polarity to the magnetic needle, but to all bodies which have any portion of iron in them, as brick, &c; and, by observing which way the poles of these bodies lie, the direction in which the stroke has passed may be known with the utmost certainty.

In order to demonstrate, by actual experiment, the identity of the electric fluid with the mattter of lightniug, Doctor Franklin contrived to bring lightning from the heavens by means of an electrical kite, which he raised on the approach of a thunder storm; and, with the electricity thus obtained, charged phials, kindled spirits, and performed all other electrical experiments, as they are usually exhibited by an excited globe or tube. This happened in 1752, a month after the French electricians, pursuing the method which he had proposed, had verified the same theory; but without any knowledge on his part of what they had done. On the following year, he further discovered that the air is sometimes electrified positively, and sometimes negatively; and that, in the course of one thunder-storm, the clouds change from positive to negative electricity several times. He was not long in perceiving that this important discovery was capable of being applied to practical use; and proposed a method, which he soon accomplished, of securing buildings from being damaged by lightning, by means of conductors, the use of which is now universally known.

From a number of judicious experiments made by him,

Signor Beccaria concludes that the clouds serve as conductors to convey the electric fluid from those parts of the earth which are overloaded with it, to those where it is exhausted. The same cause by which a cloud is first raised, from vapours dispersed in atmosphere, draws to it those which are already formed, and still continues to form new ones, till the whole collected mass extends so far as to reach a part of the earth where there is a deficiency of the electric fluid, and where the electric matter will discharge itself on the earth. A channel of communication being thus produced, a fresh supply of electric matter is raised from the overloaded part, which continues to be conveyed by the medium of the clouds, till the equilibrium of the fluid is restored between the two places of the earth. He further observes that as the wind constantly blows from the place where the thunder cloud proceeds, the sudden accumulation of such a prodigious quantity of vapours must displace the air, and repel it on all sides. Indeed, many observations of the descent of lightning confirm his theory of the mode of its ascent; for it often throws before it the parts of conducting bodies, and distributes them along the resisting medium through which it must force its passage; and on this principle the longest flashes of lightning seem to be produced, by its forcing in its way part of the vapours in the air. One of the chief reasons why the report of these flashes is so much protracted, is the vast length of the vacuum made by the passage of the electric matter; for although the air collapses the moment after it has passed, and the vibration, on which the sound depends, commences at the same moment, still, when the flash is directed towards the person who hears the report, the vibrations excited at the nearer end of the track will reach his ear much sooner than those from the remote end, and the sound will, without any echo or repercussion, continue till all the vibrations have successively reached him. The rattling noise of the thunder, which makes it seem as if it passed through arches or were variously broken, is probably owing to the sound being excited among clouds hanging over one another, and the agitated air passing irregularly between them.

Among other precautions pointed out by Doctor Franklin, he recommends to those who happen to be in the fields, at the time of a thunder-storm, to place themselves within a

few yards of a tree, but not quite near it. Signor Beccaria, however, cautions persons not to depend on a higher, or, in all cases, a better conductor than their own body; since, according to his repeated observations, the lightning by no means descends in one undivided track, but bodies of various kinds conduct their share of it at the same time, in proportion to their quantity and conducting power. The late earl Stanhope, in his principles of Electricity, observes that damage may be done by lightning, not only by the main stroke and lateral explosion, but likewise by what he calls THE RETURNING STROKE; that is, by the sudden violent return of that part of the natural share of electricity of any conducting body, or any combination of conducting bodies, which had been gradually expelled from such body or bodies respectively, by the superinduced elastic electrical pressure of a thunder-cloud's electrical atmospheres.

Among the awful phenomena of nature, none have excited more terror than thunder and lightning. It is recorded of several of the profligate Roman Emperors, who had procured themselves to be deified, that when they heard the thunder, they tremblingly concealed themselves, acknowledging a divine power greater than their own—*a Jupiter thundering in the heavens.*

REMARKABLE THUNDER-STORMS.

A FEW instances in which the effects of these storms have been particularly characterised, will be both interesting and instructive.

That fermented liquors are apt to be soured and spoiled by thunder, is a fact well known; but that dried substances should be so acted on, is a still more remarkable phenomenon, and not so easy of explanation. It happened, however, some years ago, that in the immense granaries of DANTZIC, the repositories of the corn, of Polish growth, intended for exportation, the wheat and rye, which were before dry and sweet, were, by the effect of a violent thunder-storm in the night, rendered clammy and stinking, insomuch that it required several weeks to sweeten them and render them fit for shipping.

The effects of a thunder-storm on a house and its furniture, at NEW FORGE, Ireland, on the 9th of August, 1707, were very singular. It was observed that the day

was throughout close, hot, and sultry, with scarcely any wind, until towards the evening, when a breeze came on with mizzling rain, which lasted about an hour. As the air darkened after sun-set, several faint flashes of lightning were seen, and thunder-claps heard, as at a distance; but between ten and eleven o'clock they became, in their approach, very violent and terrible, progressively increasing in their intensity, and coming on with more frequency, until towards midnight. A flash of lightning, and clap of thunder, louder and more dreadful than all the rest, came simultaneously, and shook and inflamed the whole house. The mistress being sensible at that instant of a strong sulphureous smell in her chamber, and feeling a thick gross dust fall on her hands and face as she lay in bed, concluded that part of her house had been thrown down by the thunder, or set on fire by the lightning. The family being called up, and candles lighted, both the bed-chamber, and the kitchen, beneath it, were found to be filled with smoke and dust. A looking-glass in the chamber had been broken with such violence, that not a piece of it was to be found of the size of half a crown: several of the pieces were stuck in the chamber door, which was of oak, as well as on the other side of the room. The edges and corners of some of the pieces of broken glass were tinged of a light flame colour, as if they had been heated by the fire.

On the following morning it was found that the cornice of the chimney next the bed-chamber had been struck off, and a breach twenty inches in breadth, made in the wall. At this part there was seen on the wall a smutted scar or trace, as if left by the smoke of a candle, which pointed downward to another part of the wall, where a similar breach was made. Within the chamber, the boards on the back of a large hair trunk, filled with linen, were forced in: two thirds of the linen were pierced or cut through, the cut appearing of a quadrangular figure. Several pieces of muslin and wearing apparel, which lay on the trunk, were dispersed about the room, not in any way singed or scorched, notwithstanding the hair on the back of the trunk, where the breach was made, was singed. In the kitchen, a cat was found dead, with its legs extended as in a moving posture, without any other sign of being hurt, except that the fur was singed a little about the rump.

In the parish of SAMFORD-COURTNEY, near Oakhampton, in Devon, on the 7th of October, 1811, about three in the afternoon, a sudden darkness came on. Several persons being in the church-porch, a great fire-ball fell among them, and threw them down in various directions, but without any one being hurt. The ringers in the belfry declared that they never knew the bells go so heavy, and were obliged to desist ringing. Looking down from the belfry into the church, they perceived four fire-balls, which suddenly burst, and the church was filled with fire and smoke. One of the congregation received a blow in the neck, which caused him to bleed both at nose and mouth. He observed the fire and smoke to ascend to the tower, where a large beam, on which one of the bells was hung, was broken, and the gudgeon breaking, the bell fell to the floor. One of the pinnacles of the tower, next the town, was carried away, and several of the stones were found near a barn, at a considerable distance from the church.

On the 15th of December, 1754, a vast body of lightning fell on the great hulk at Plymouth. It burst out a mile or two to the westward of the hulk, and rushed towards it with incredible velocity. A portion of the derrick (a part of the apparatus which serves to hoist in and fix the masts of the men of war) was cut out, of a diameter of at least eighteen inches, and about fifteen feet in length: this particular piece was in three or four places girt with iron hoops, about two inches broad, and half an inch thick, which were completely cut in two by the lightning, as if done by the nicest hand and instrument. The lightning was immediately succeeded by a dreadful peal of thunder, and that by a most violent shower of hail, the hail-stones being as large as nutmegs, and for the greatest part of the same size and shape.

Among the many fatal accidents by lightning which have befallen ships, the following is a remarkable instance. In the year, 1746, a Dutch ship lay in the road of Batavia, and was preparing to depart for Bengal. The afternoon was calm, and towards evening the sails were loosed, to take advantage of the wind which then constantly blows from the land. A black cloud gathered over the hills, and was brought by the wind towards the ship, which it had no sooner reached, than a clap of thunder burst from it,

and the lightning set fire to the main-top-sail: this being very dry, burned with great fury; and thus the rigging and mast were set on fire. An attempt was immediately made to cut away the mast, but this was prevented by the falling of the burnt rigging from the head of the mast. By degrees the fire communicated to the other masts, and obliged the crew to desert the ship, the hull of which afterwards took fire, and, burning down to the powder magazine, the upper part was blown into the air, and the lower part sunk where the ship was at anchor.

In crossing the Atlantic, in the month of November, 1749, the crew of an English ship observed a large ball of blue fire rolling on the water. It came down on them so fast, that before they could raise the main tack, they observed the ball to rise almost perpendicularly, and within a few yards of the main chains: it went off with an explosion as if hundreds of cannon had been fired off simultaneously, and left behind it a great smell of brimstone. The main-top-mast was shattered into a thousand pieces, and spikes driven out of the main-mast which stuck in the main-deck. Five seamen were knocked down, and one of them greatly burnt, by the explosion. The fire-ball was of the apparent size of a large mill-stone, and came from the N. E.

The ingenious and indefatigable Professor Richman lost his life on the 6th of August, 1753, as he was observing, with M. Sokolow, engraver to the Royal Academy of St. Petersburgh, the effects of electricity on his gnomon, during a thunder-storm. It was ascertained that the lightning was more particularly directed into the professor's apartment, by the means of his electrical apparatus, for M. Sokolow distinctly saw a globe of blue fire, as large as his clenched hand, jump from the rod of the right gnomon, towards the forehead of Professor Richman, who at that instant was about a foot distant from the rod, observing the electrical index. The globe of fire which struck the Professor, was attended with a report as loud as that of a pistol. The nearest metal wire was broken in pieces, and its fragments thrown on M. Sokolow's clothes, on which burnt marks of their dimensions were left. Half of the glass vessel was broken off, and the metallic filings it contained thrown about the room. Hence it is plain that the force of the lightning was collected on the right rod, which

touched the filings of metal in the glass vessel. On examining the effects of the lightning in the Professor's chamber, the door-case was found split half through; and the door torn off, and thrown into the chamber. The lightning therefore seems to have continued its course along the chain conducted under the ceiling of the apartment.

In a Latin treatise, published by M. Lomonosow, member of the Royal Academy of Sciences of St. Petersburgh, several curious particulars are mentioned relative to this melancholy catastrophe. At the time of his death, Professor Richman had in his left coat-pocket seventy silver coins, called rubles, which were not in the least altered by the accident which befel him. His clock, which stood in the corner of the next room, between an open window and the door, was stopped; and the ashes from the hearth thrown about the apartment. Many persons without doors declared that they actually saw the lightning shoot from the cloud to the Professor's apparatus at the top of his house. The author in speaking of the phenomena of electricity, observes that he once saw during a storm of thunder and lightning, brushes of electrical fire, with a hissing noise, communicate between the iron rod of his apparatus and the side of his window, and that these were three feet in length, and a foot in breadth.

HAIL STORMS.

On the 17th of July, 1666, a violent storm of hail fell on the coasts of Norfolk and Suffolk. At North Yarmouth the hail-stones were comparitively small; but at Snapebridge one was taken up which measured a foot in circumference; at Seckford Hall, one which measured nine inches; and at Melton, one measuring eight inches. At Friston Hall, one of these hail-stones, being put into a balance, weighed two ounces and a half. At Aldborough, it was affirmed that several of them were as large as turkies' eggs. A carter had his head broken by them through a stiff felt hat: in some places it bled, and in others tumours arose: the horses were so pelted that they hurried away his cart beyond all command. The hail-stones were white, smooth without, and shining within.

On the 25th of May, 1686, the city of Lille, in Flanders, was visited by a tremendous hail storm. The hail-stones

weighed from a quarter of a pound to a pound weight, and even more. One among the rest was observed to contain in the centre a dark brown matter, and being thrown into the fire, gave a very loud report. Others were transparent, and melted instantly before the fire. This storm passed over the city and citadel, leaving not a whole glass in the windows on the windward side. The trees were broken, and some beaten down, and partridges and hares killed in abundance.

In 1697, a horrid black cloud, attended with frequent lightnings and thunder, coming with a south-west wind out of Carnarvonshire, and passing near Snowdon, was the precursor of a most tremendous hail-storm. In the part of Denbigshire bordering on the sea, all the windows on the weather side were broken by the hail-stones discharged from this cloud, and the poultry and lambs, together with a large mastiff, killed. In the north part of Flintshire several persons had their heads broken, and were grievously bruised in their limbs. The main body of this hail storm fell on Lancashire, in a right line from Ormskirk to Blackburn, on the borders of Yorkshire. The breadth of the cloud was about two miles, within which compass it did incredible damage, killing all descriptions of fowl and small creatures, and scarcely leaving a whole pane of glass in any of the windows where it passed. What was still worse it ploughed up the earth, and cut off the blade of the green corn, so as utterly to destroy it, the hail-stones burying themselves in the ground. These hail-stones, some of which weighed five-ounces, were of different forms, some round, others semi-spherical; some smooth, others embossed and crenulated, like the foot of a drinking glass, the ice being very transparent and hard; but a snowy kernel was in the midst of most of them, if not of all. The force of their fall showed that they descended from a great height. What was thought to be most extraordinary in this phenomenon was, that the vapour which disposed the aqueous parts thus to congeal, should have continued undispersed for so long a tract as upwards of sixty miles, and should during this extensive passage, have occasioned so extraordinary a coagulation and congelation of the watery clouds, as to increase the hail-stones to so vast a bulk in so short a space as that of their fall.

On the 4th of May, 1767, at Hitchin in Hertfordshire, after a violent thunder-storm, a black cloud suddenly arose in the south-west, about two o'clock in the afternoon, the wind then blowing strongly in the east, and was almost instantly followed by a shower of hail, several of the hail-stones which fell measuring from seven or eight to thirteen or fourteen inches in diameter. The extremity of the storm fell near Offley, where a young man was killed, and one of his eyes were beaten out of his head, his body being in every part covered with bruises. Another person, nearer to Offley, escaped with his life, but was much bruised. At a nobleman's seat in the vicinity, seven thousand squares of glass were broken, and great damage was done to all the neighbouring houses. The large hail stones fell in such immense quantities, that they tore up the ground, and split many large oaks and other trees, cutting down extensive fields of rye, and destroying several hundred acres of wheat, barley, &c. Their figures were various, some being oval, others round, others pointed, and others again flat.

HURRICANES.

The ruin and desolation accompanying a hurricane can scarcely be described. Like fire, its resistless force rapidly consumes every thing in its track. It is generally preceded by an awful stillness of the elements, and a closeness and mistiness in the atmosphere, which make the sun appear red, and the stars of more than an ordinary magnitude. But a dreadful reverse succeeding, the sky is suddenly overcast and wild; the sea rises at once from a profound calm into mountains; the wind rages and roars like the noise of cannon; the rain descends in a deluge; a dismal obscurity envelopes the earth with darkness; and the superior regions appear rent with lightning and thunder. The earth, on these occasions, often does, and always seems to tremble, while terror and consternation distract all nature: birds are carried from the woods into the ocean; and those whose element is the sea, fly for refuge on land. The affrighted animals in the fields assemble together, and are almost suffocated by the impetuosity of the wind, in searching for shelter, which, when found, serves them only for destruc-

tion. The roofs of houses are carried to vast distances from their walls, which are beaten to the ground, burying their inmates beneath them. Large trees are torn up by the roots, and huge branches shivered off, and driven through the air in every direction, with immense velocity. Every tree and shrub that withstands the shock, is stripped of its boughs and foilage. Plants and grass are laid flat to the earth. Luxuriant spring is in a moment changed to dreary winter. This direful tragedy ended, when it happens in a town, the devastation is surveyed with accumulated horror: the harbour is covered with wrecks of boats and vessels; and the shore has not a vestige of its former state remaining. Mounds of rubbish and rafters in one place; heaps of earth and trunks of trees in another; deep gullies from torrents of water; and the dead and dying bodies of men, women, and children, half buried, and scattered about, where streets but a few hours before were, present to the miserable survivors a shocking conclusion of a spectacle to be followed by famine, and, when accompanied by an earthquake, by mortal diseases.

Such is the true and terrific picture of a hurricane in the West Indies, as drawn by Doctor Mosely, in his treatise on tropical diseases!

On the Indian coast hurricanes are both frequent and disastrous. On the 2d of October, 1746, the French squadron, commanded by Le Bourdonnai, being at anchor in Madras roads, a hurricane came on which in a few hours destroyed nearly the whole of the fleet, together with twenty other ships belonging to different nations. One of the French ships foundered in an instant, and only six of the crew were saved. On the 30th of Dec. 1760, during the siege of Pondicherry, a tremendous hurricane drove on shore, and wrecked, three British ships belonging to the besieging squadron: the crews were saved. On the 20th of October of the following year, 1761, the British fleet, then lying in Madras roads, had to encounter a violent hurricane. The men of war put to sea, and were thus providentially saved; but all the vessels which still lay at anchor were lost, and scarcely a soul on board saved. On the 29th of October 1768, another hurricane was, on the coast of Coromandel, fatal to the Chatham Indiaman, which neglected to put to sea.

In the West Indies, the late tremendous hurricane of the 21st of October, 1817, was particularly severe at the Island of St. Lucie. All the vessels in the port were entirely lost. The Government-house was blown down, and all within its walls, comprising the Governor, his lady, and child, his staff, secretaries, servants, &c. amounting to about thirty persons buried in its ruins: not one survived the dreadful accident; and still more horrid to relate, the barracks of the officers and soldiers were demolished, and all within them (about two hundred persons) lost. *All the* estates on the island were reduced to a heap of ashes. At Dominica, nearly the whole of the town was inundated, with an immense destruction of property.

In Great Britain, a dreadful hurricane, commonly called the great storm, set in at ten at night, on the 26th of November, 1703, and raged violently until seven the next morning. It extended its ravages to every part of the kingdom. In the capital, upwards of two thousand stacks of chimnies were blown down. The lead on the tops of several churches was rolled up like skins of parchment. Many houses were levelled with the ground, and by the fall of the ruins, 21 persons were killed, and more than 200 wounded. The ships in the Thames broke from their moorings: four hundred wherries were lost, and many barges sunk, with a great loss of lives. At sea the destruction was still greater: twelve ships of war, with upwards of eighteen hundred men on board, were totally lost, together with many merchantmen.

THE MONSOONS.

The setting in of the Monsoon, or tropical sea wind, in the East Indies, is thus described by Forbes in his Oriental Memoirs. The scene was at Baroche, where the British army was encamped. "The shades of evening approached as we reached the ground, and just as the encampment was completed, the atmosphere grew suddenly dark, the heat became oppressive, and an unusual stillness presaged the immediate setting in of the monsoon. The whole appearance of nature resembled those solemn preludes to earthquakes and hurricanes in the West Indies, from which the east in general is providentially free. We are allowed very

little time for conjecture; in a few minutes the heavy clouds burst over us.

"I had witnessed seventeen monsoons in India, but this exceeded them all in its awful appearance and dreadful effects. Encamped in a low situation, on the borders of a lake formed to collect the surrounding water, we found ourselves in a few hours in a liquid plain. The tent-pins giving way, in a loose soil, the tents fell down, and left the whole army exposed to the contending elements. It requires a lively imagination to conceive the situation of an hundred thousand human beings of every description, with more than two hundred thousand elephants, camels, horses, and oxen, suddenly overwhelmed by this dreadful storm, in a strange country, without any knowledge of high or low ground; the whole being covered by an immense lake, and surrounded by thick darkness, which prevented our distinguishing a single object, except such as the vivid glare of lightning displayed in horrible forms. No language can describe the wreck of a large encampment thus instantaneously destroyed, and covered with water; amid the cries of old men and helpless women, terrified by the piercing shrieks of their expiring children, unable to afford them relief. During this dreadful night, more than two hundred persons and three thousand cattle perished, and the morning dawn exhibited a shocking spectacle."

The south-west monsoon generally sets in very early in certain parts of India. "At Anjengo," observes the above author, "it commences with great severity, and presents an awful spectacle; the inclement weather continues, with more or less violence, from May to October: during that period, the tempestuous ocean rolls from a black horizon, literally of 'darkness visible,' a series of floating mountains heaving under hoary summits, until they approach the shore, when their stupendous accumulations flow in successive surges, and break upon the beach; every ninth wave is observed to be generally more tremendous than the rest, and threatens to overwhelm the settlement. The noise of these billows equals that of the loudest cannon, and, with the thunder and lightning, so frequent in the rainy season, is truly awful. During the tedious monsoon I passed at Anjengo, I often stood upon the trembling sand-bank, to contemplate the solemn scene, and derive comfort from

that sublime and omnipotent decree. 'Hitherto shalt thou come, but no further; and here shall thy proud waves be stayed!'"

WHIRLWINDS AND WATERSPOUTS.

[*See Plates, No.* 49, 50, 51.]

> ——————the dreadful spout
> Which shipmen do the hurricano call
> Constring'd in mass by the almighty sun.
> SHAKSPEARE (*Troilus and Cressida.*)

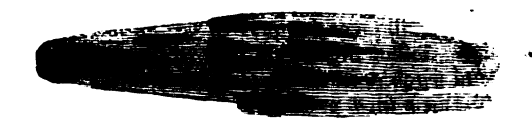
In number 302 of the Monthly Magazine, Sir Richard Phillips, in describing a water-spout observed by him, points out the connexion between those phenomena, and offers a very philosophical explanation of the formation of the latter.

"It happened to him," he observes, "on the 27th of June, 1817, about seven in the evening, to witness the formation, operation, and extinction of what is called a water-spout; His attention was drawn to a sudden hurricane which nearly tore up the shrubs and vegetables in the western gardens, and filled the air with leaves and small collections of the recently-cut grass. Very dark clouds had collected over the adjacent country, and some stormy rain, accompanied by several strokes of lightning, followed this hurricane of wind. The violence lasted a few minutes, and the writer being drawn to an eastern balcony, it was evident that a whirlwind agitated a variety of substances which had been raised into the air. The storm proceeded from west to east, that is, from Hampstead over Kentish-Town towards Holloway. In about five minutes, in the direction of the latter place, a magnificent projection was visible from the clouds, like what is represented by *Fig.* 1 in the plate. It descended two-thirds of the distance from the clouds towards the earth, and evidently consisted of parts of clouds descending in a vortex, violently agitated like smoke from the chimney of a furnace recently supplied with fuel. It then shortened, and appeared to be drawn up towards the stratum of clouds, and presently it assumed the appearance represented by *Fig.* 2.

It finally drew itself into the cloud; but a small cone, or projecting thread, of varying size and length, continued for ten minutes. At the time, and for half an hour after, a

No. 50.—*Water Spout on Land.-Fig. 2.*

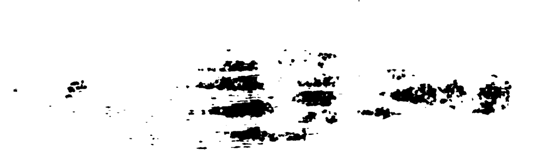
No. 51.—*Water Spout.-Fig. 1.*



No. 52.—*Flight of Meteoric Stones.*







severe storm of rain was visibly falling from the ruins of clouds connected with it, the extent being exactly defined by the breadth of Holloway, Highgate, and Hornsey.—About two hours after, on walking from Kentish-Town towards Holloway, it was found that one of the heaviest torrents of rain remembered by the inhabitants had fallen around the foot of Highgate-hill; and some persons having seen the projecting cloud, an absolute belief existed that a water spout had burst at the crossing of the new and old roads. On proceeding towards London, various accounts agreeing with the superstition or pre-conceived notions of the bye-standers, were given; but, in the farm-yard at the three-mile stone, it appeared that some hay-makers were stacking hay from a waggon which stood between two ricks, and that the same whirlwind which passed over Kentish-Town, had passed over the loaded waggon with an impetus sufficient to carry it above twenty yards from its station, and to put the men upon it, and on the rick, in fear of their lives. Passing the road, it carried with it a stream of hay, and, nearly unroofing a shed on the other side, filled the air to a great height with fragments of hay, leaves, and boughs of trees, which resembled a vast flight of birds. The family of the writer beheld the descending cloud, or water-spout, pass over, and they saw its train, which, at the time, they took to be a flight of birds. They afterwards beheld the descending cloud draw itself upward, and they, and other witnesses, describe it as a vast mass of smoke working about in agitation; to them it was nearly vertical in a northern direction; and to persons a quarter of a mile north, it was nearly vertical in a southern direction; and all agree that it drew itself up without rain, and was followed near the earth by the train of light bodies. It appeared also, on various testimony, to let itself down in a gradual and hesitating manner, beginning with a sort of knob in the cloud, and then descending lower, and curling and twisting about till it shortened, and gradually drew itself into the cloud."

The inferences which Sir Richard draws from what he saw and heard, are as follow: "That the phenomenon called a water-spout is a mere collection of clouds, of the same rarity as the mass whence they are drawn. That the descent is a mechanical effect of the whirlwind, which creating a

vacuum, or high degree of rarefaction, extending between the clouds and the earth, the clouds descended in it by their gravity, or by the pressure of the surrounding clouds or air. That the convolutions of the descending mass, and the sensible whirlwind felt at the earth, as well as the appearance of the commencement, increase, and decrease, of the mass, all demonstrate the whirl of the air to be the mechanical cause.—That the same vortex, whirl, or eddy, of the air, which occasions the clouds to descend, occasions the loose bodies on the earth to ascend.—That, if in this case the lower surface had been water, the same mechanical power would have raised a body of foam, vapour, and water, towards the clouds.—That, as soon as the vortex or whirl exhausts or dissipates itself, the phenomena terminate by the fall to the lower surface of the light bodies or water, and by the ascent of the cloud.—That when water constitutes the light body of the lower surface, it is probable that the aqueous vapour of the cloud, by coalescing with it, may occasion the clouds to condense, and fall at that point, as through a syphon.—That if the descending cloud be highly electrified, and the vortex pass over a conducting body, as a church steeple, it is probable it may be condensed by an electrical concussion, and fall at that spot—discharging whatever has been taken up from the lower surface, and producing the strange phenomena of showers of frogs, fish, &c.—And, lastly, it appears certain, that the action of the air on the mass of clouds, pressing towards the mouth of the vortex as to a funnel (which, in this case, it exactly represented,) occasioned such a condensation as to augment the simultaneous fall of rain to a prodigy."

In the month of July, 1800, a water-spout was seen rapidly to approach a ship navigating between the Lipari Islands. It had the appearance of a viscid fluid, tapering in its descent, and proceeding from the cloud to join the sea. It moved at the rate of about two miles an hour, with a loud sound of rain, passing the stern of the ship, and wetting the after part of the mainsail. It was thence concluded that water-spouts are not continuous columns of water, as has been confirmed by subsequent observations.

In November, 1801, about twenty miles from Trieste, in the Adriatic sea, a water-spout was seen eight miles to the southward: round its lower extremity was a mist, twelve

feet high, nearly of the form of an Ionian capital, with very large volutes, the spout resting obliquely on its crown. At some distance from this spout, the sea began to be agitated, and a mist rose to the height of about four feet: a projection then descended from the black cloud which was impending, and met the ascending mist about twenty feet above the sea, the last ten yards of the distance being described with great rapidity. A cloud of a light colour appeared to ascend in this cloud like quicksilver in a glass tube. The first spout then snapped at about one third of its height, the inferior part subsiding gradually, and the superior curling upward.

Several other projections from the cloud, appeared with corresponding agitations of the water below, but not always in spouts vertically under them: seven spouts in all were formed; and two other projections re-absorbed. Some of the spouts were not only oblique, but curved, the ascending cloud moving most rapidly in those which were vertical. They lasted from three to five minutes, and their dissipation was not attended with any fall of rain. For some days before the weather had been very rainy, with a S. E. wind; but not any rain had fallen on the day of observation.*

The corresponding phenomena of whirlwinds have been occasionally productive of much mischief, as the following brief narratives will show. On the 30th of October, 1669, about six in the evening, the wind being then westwardly, a formidable whirlwind, scarcely of the breadth of sixty yards, and which spent itself in about seven minutes, arose at Ashly, in Northamptonshire. Its first assault was on a milk-maid, whose pail and hat were taken from off her head, and the former carried many scores of yards from her, where it lay undiscovered for some days. It next stormed a farm-yard, where it blew a waggon body off the axletrees, breaking in pieces the latter, and the wheels, three of which, thus shattered, were blown over a wall. Another waggon, which did not like the former, lie across the passage of the wind, was driven with great speed against the side of the farm house. A branch of an ash-tree, so

* In the plate representing the two figures of a water-spout, the passage of a cluster of aerolites, or meteoric stones, through the air, is likewise described; and to that subject the reader's attion is directed in viewing the plate.

large that two stout men could scarcely lift it, was blown over a house without damaging it, although torn from a tree 100 yards distant. A slate was carried nearly 200 yards, and forced against a window, the iron bar of which it bent. Several houses were stripped; and in one instance, this powerful gust, or stream of air, forced open a door, breaking the latch; whence it passed through the entry, and, forcing open the dairy door, overturned the milk-pans, and blew out three panes of glass. It next ascended to the chambers, and blew out nine other panes. Lastly, it blew a gate-post, fixed two feet and a half in the ground, out of the earth, and carried it many yards into the fields.

On the 30th of October, 1731, at one in the morning, a very sudden and terrific whirlwind, having a breadth of two hundred yards, was experienced at Cerne-Abbas, in Dorsetshire. From the south-west side of the town, it passed to the north-east, crossing the centre, and unroofing the houses in its progress. It rooted up trees, broke others in the middle, of at least a foot square, and carried the tops a considerable distance. A sign-post, five feet by four, was broken off six feet in the pole, and carried across a street forty feet in breadth, over a house opposite. The pinnacles and battlements of one side of the church-tower were thrown down, and the leads and timber of the north aisle broken in by their fall. A short time before, the air was remarkably calm. It was estimated that this sudden and terrible gust did not last more than two minutes.

About the middle of August, 1741, at ten in the morning, several peasants being on a heath near Holkham in Norfolk, perceived, about a quarter of a mile from them, a wind like a whirlwind approach them gradually, in a strait line from east to west. It passed through the field where they were ploughing, and tore up the stubble and grass in the ploughed ground, for two miles in length, to the breadth of thirty yards. In reaching an enclosure at the top of a rising ground, it appeared like a great flash or ball of fire, emitting smoke, and accompanied by a noise similar to that of carts passing over a stony ground. Both before and after the wind passed, there was a strong smell of sulphur; and the noise was heard long after the smoke had been perceived. This fiery whirlwind moved so slowly forward, that it was nearly ten minutes in proceeding from

the enclosure to a farm-house in the vicinity, where it did much mischief.

SOUNDS AND ECHOES.

SOUND is propagated successively from the sounding body to the places which are nearest to it, then to those more distant, &c. Every observer knows that when a gun is fired at a considerable distance from him, he perceives the flash a certain time before he hears the report; and the same thing is true with respect to the stroke of a hammer, or of a hatchet, the fall of a stone, or, in short, any visible action which produces a sound or sounds. In general, sound travels through the air at the rate of 1142 feet in a second, or about thirteen miles in a minute. This is the case with all kinds of sounds, the softest whisper flying as fast as the loudest thunder. Sound, like light, after it has been reflected from several places, may be collected into one point as a focus, where it will be more audible than in any other part; and on this principle WHISPERING GALLERIES are constructed.

The particulars relative to the celebrated whispering gallery in the Dome of St. Paul's Church, London, will be comprehended in the description of that noble edifice.

AN ECHO is the reflection of sound striking against a surface adapted to the purpose, as the side of a house, a brick wall, hill, &c. and returning back again to the ear, at distinct intervals of time. If a person stand about sixty-five or seventy feet from such a surface, and perpendicular to it, and speak, the sound will strike against the wall, and be reflected back, so that, he will hear it as it goes to the wall, and again on its return. If a bell situated in the same way be struck, and an observer stand between the bell and the reflecting surface, he will hear the sound going to the wall, and also on its return. Lastly, if the sound strike the wall obliquely, it will go off obliquely, so that a person who stands in a direct line between the bell and the wall will not hear the echo.

According to the greater or less distance from the speaker, a reflecting object will return the echo of several, or of fewer syllables; for all the syllables must be uttered before the echo of the first syllable reaches the ear, to prevent the confusion which would otherwise ensue. In a moderate

way of speaking, about three and a half syllables are pronounced in one second, or seven syllables in two seconds: therefore, when an echo repeats seven syllables, the reflecting object is 1142 feet distant; for sound travels at the rate of 1142 feet per second, and the distance from the speaker to the reflecting object, and again from the latter to the former, is twice 1142 feet. When the echo returns fourteen syllables, the reflecting object must be 2284 feet distant, and so on.

The most remarkable echo recorded, is at the palace of a nobleman, within two miles of Milan, in Italy. The building is of some length in front, and has two wings jutting forward; so that it wants only one side of an oblong figure. About one hundred paces before the mansion, a small brook glides gently; and over this brook is a bridge forming a communication between the mansion and the garden. A pistol having been fired at this spot, fifty-six reiterations of the report were heard. The first twenty were distinct; but in proportion as the sound died away, and was answered at a greater distance, the repetitions were so doubled that they could scarcely be counted, the principal sound appearing to be saluted in its passage by reports on either side at the same time. A pistol of a larger calibre having been afterwards discharged, and consequently with a louder report, sixty distinct reiterations were counted.

From this example it follows, that the farther the reflecting surface is, the greater number of syllables the echo will repeat; but that the sound will be enfeebled nearly in the same proportion, until at length the syllables cannot be distinctly heard. On the other hand, when the reflecting object is too near, the repetition of the sound reaches the ear, whilst the perception of the original sound still continues, in which case an indistinct resounding is heard, as may be observed in empty rooms, passages, &c. In such places, several reflections from the walls to the hearer, as also from one wall to the other, and then to the hearer, clash with each other, and increase the indistinction.

MISCELLANEOUS WONDERS OF NATURE.

THE GREAT SERPENT, CALLED THE BOA CONSTRICTOR.

Ye too, in other climes who harmless rove
In gilded scales, the guardians of the grave,
In horrid Afric's pestilential air
Acquire new natures from the burning glare;
Ride through the blaze of noon on sable wing,
Quick on th' affrighted herds with fury spring,
And gathering all your folds in wreathings dire,
Bid the huge ox beneath your crush expire:
Th' enormous elephant by force can slay,
And need no poison to secure your prey.

AMONG serpents, the genus BOA is distinguished by its vast, and, indeed, almost unlimited size, as well as by its prodigious strength, which enables it to destroy cattle, deer, &c. by twisting around them in such a manner as to crush them to death by continual pressure. It also claims a superiority over other serpents by the beauty of its colours, and the peculiar disposition of its variegations. The entire ground colour of this animal, in the younger specimens, is a yellowish grey, and sometimes a bright yellow, on which is disposed, along the whole length of the back, a series of large, chain-like, reddish brown, and sometimes perfectly red variegations, leaving large open spaces of the ground colour at regular intervals. The largest, or principal marks, composing the above chain-like pattern, are of a squarish form, accompanied on their exterior sides by large triangular spots, with their points directed downward. Between these larger marks are disposed many smaller ones of uncertain forms, and more or less numerous in different parts. The ground colour itself is also scattered over by many small specks of the same colour with the variegations. The exterior edges of all the larger spots and markings are commonly blackish, or of a much deeper cast than the middle part, and the ground colour immediately accompanying the outward edges of the spots is, on the contrary, lighter than on the other parts, or even whitish, thus constituting a general richness of pattern, of which nothing but an actual view of a highly-coloured specimen

of the animal itself can convey a complete idea. In larger specimens, the yellow tinge is often lost in an uniform grey cast, and the red tinge of the variegations sinks into a deep chesnut: in some instances the general regularity of the pattern, as above described, is disturbed by a kind of confluent appearance. The head is invariably marked above by a large longitudinal dark band, and by a narrower lateral band passing across the eyes towards the neck.

It was, in all probability, an enormous specimen of this very serpent which once threw a whole Roman army into dismay. The fact is recorded by Valerius Maximus, who quotes it from one of the lost books of Livy, where it was detailed at a greater length. He relates that near the river Bagrada, in Africa, a snake was seen of so enormous a magnitude as to prevent the army of Attilius Regulus from the use of the river; and which, after having snatched up several soldiers with its enormous mouth, and killed several others by striking and squeezing them with the spires of its tail, was at length destroyed by assailing it with all the force of military engines and showers of stones, after it had withstood the attack of their spears and darts. It was regarded by the whole army as a more formidable enemy than even Carthage itself. The whole adjacent region was tainted with the pestilential effluvia proceeding from its remains, as were the waters with its blood, so as to oblige the Roman army to shift its station. The skin of this monster, measuring in length *one hundred and twenty feet*, was sent to Rome as a trophy, and was there suspended in a temple, where it remained till the time of the Numidian war.

In the narrative of Mr. Mc Leod, surgeon of the Alceste frigate, which conveyed the late embassy to China, and was wrecked in the Straits of Gaspar, is an account of a BOA CONSTRICTOR having been embarked on board the Cæsar, the vessel which brought home the officers and crew of the shipwrecked frigate. The details are of great interest; but the mode in which this prodigy of nature was, during the passage, supplied with its food, causes humanity to shudder. Well may Sir Richard Phillips have remarked, in the supplementary number of the Monthly Magazine, [No. 307. p. 646.] that the parties guilty of the atrocious.

act about to be described, ought themselves to have been made to exchange places with the helpless goat!

The BOA CONSTRICTOR was a native of Borneo, and had been sent to Batavia, where he was embarked. "He was brought on board shut up in a wooden crib or cage, the bars of which were sufficiently close to prevent his escape; and it had a sliding door, for the purpose of admitting the articles on which he was to subsist; the dimensions of the crib were about four feet high, and about five feet square, a space sufficiently large to allow him to coil himself round with ease. The live stock for his use during the passage, consisting of six goats of the ordinary size, were sent with him on board, five being considered as a fair allowance for as many months. At an early period of the voyage we had an exhibition of his talent in the way of eating, which was publicly performed on the quarter-deck, upon which he was brought. The sliding-door being opened, one of the goats was thrust in, and the door of the cage shut. The poor goat, as if instantly aware of all the horrors of its perilous situation, immediately began to utter the most piercing and distressing cries, butting instinctively, at the same time, with its head towards the serpent, in self-defence.

"The snake, which at first appeared scarcely to notice the poor animal, soon began to stir a little, and, turning his head in the direction of the goat, it at length fixed a deadly and malignant eye on the trembling victim, whose agony and terror seemed to increase; for previous to the snake seizing its prey, it shook in every limb, but still continuing its unavailing show of attack, by butting at the serpent, who now became sufficiently animated to prepare for the banquet. The first operation was that of darting out his forked tongue, and at the same time rearing a little his head; then suddenly seizing the goat by the fore-leg with his mouth, and throwing him down, he was encircled in an instant in its horrid folds. So quick, indeed, and so instantaneous was the act, that it was impossible for the eye to follow the rapid convolution of his elongated body. It was not a regular screw-like turn that was formed, but resembling rather a knot, one part of the body overlaying the other, as if to add weight to the muscular pressure, the more effectually to crush his object. During this time he

continued to grasp with his mouth, though it appeared an unnecessary precaution, that part of the animal which he had first seized. The poor goat, in the meantime, continued its feeble and half-stifled cries for some minutes, but they soon became more and more faint, and at last it expired. The snake, however, retained it for a considerable time in its grasp after it was apparently motionless. He then began slowly and cautiously to unfold himself till the goat fell dead from his monstrous embrace, when he began to prepare himself for the feast. Placing his mouth in front of the head of the dead animal, he commenced by lubricating with his saliva that part of the goat; and then taking its muzzle into his mouth, which had, and indeed always has, the appearance of a raw lacerated wound, he sucked it in, as far as the horns would allow. These protuberances opposed some little difficulty, not so much from their extent as from their points; however, they also, in a very short time, disappeared; that is to say externally; but their progress was still to be traced very distinctly on the outside, threatening every moment to protrude through the skin. The victim had now descended as far as the shoulders; and it was an astonishing sight to observe the extraordinary action of the snake's muscles when stretched to such an unnatural extent—an extent which must have utterly destroyed all muscular power in any animal that was not, like itself, endowed with very peculiar faculties of expansion and action at the same time. When his head and neck had no other appearance than that of a serpent's skin, stuffed almost to bursting, still the workings of the muscles were evident; and his power of suction, as it is erroneously called, unabated; it was, in fact, the effect of a contractile muscular power, assisted by two rows of strong hooked teeth. With all this he must be so formed as to be able to suspend, for a time, his respiration, for it is impossible to conceive that the process of breathing could be carried on while the mouth and throat were so completely stuffed and expanded by the body of the goat, and the lungs themselves (admitting the trachea to be ever so hard) compressed, as they must have been, by its passage downwards.

"The whole operation of completely gorging the goat, occupied about two hours and twenty minutes: at the end of which time the tumefaction was confined to the middle

part of the body, or stomach, the superior parts, which had been so much distended, having resumed their natural dimensions. He now coiled himself up again, and laid quietly in his usual torpid state for about three weeks or a month, when his last meal appearing to be completely digested and dissolved, he was presented with another goat, which he devoured with equal facility. It would appear that almost all he swallows is converted into nutrition, for a small quantity of calcareous matter (and that, perhaps, not a tenth part of the bones of the animal) with occasionally some of the hairs, seemed to compose his general fæces;—and this may account for these animals being able to remain so long without a supply of food. He had more difficulty in killing a fowl than a larger animal, the former being too small for his grasp.

"As we approached the Cape of Good Hope, this animal began to droop, as was then supposed, from the increasing coldness of the weather, (which may probably have had its influence,) and he refused to kill some fowls which were offered to him. Between the Cape and St. Helena he was found dead in his cage; and, on dissection, the coats of his stomach were discovered to be excoriated and perforated by worms. Nothing remained of the goat except one of the horns, every other part being dissolved."

THE SEA SERPENT.

The existence of this Marine prodigy on the coast of North America, has been placed beyond a doubt by the multiplied evidences procured by the Linnæan Society of New England established at Boston. The enquiries were founded on the rumours currently spread, on various authorities, that in the month of August, 1817, an animal of very singular appearance had been repeatedly seen in the harbour of Gloucester, Cape Ann, about thirty miles from Boston. It was said to resemble a serpent in its general form and motions, to be of immense size, and to move with wonderful rapidity; to appear on the surface of the water in calm and bright weather only; and to seem jointed, or like a number of buoys or casks following each other in a line. The following is a brief abstract of the evidences taken *on oath* in support of these rumours. The depositions were made before Lonson Nash, Esq. a magistrate of Gloucester, by whose

own account of the animal, of which he had a distinct view, it may not be improper to preface the various evidences adduced.

Mr. Nash saw the serpent at the distance of about two hundred and fifty yards. It was so long, that the two extremes were not visible *at one view*, with a telescope.—He therefore judged it to be seventy, or, perhaps, a hundred feet in length. He perceived eight distinct portions, or bunches, apparently caused by the vertical motion of the animal, which he conjectures to be straight. In this vertical motion all the testimonies agree, as well as in the apparent bunches. The track made in the water was visible for half a mile, and the progress of the animal, when on its surface, a mile in four minutes: but when immersed, by the motion of the water, which could be often traced, he appeared to move a mile in two minutes, or in three minutes at the most. His body was of the size of a half-barrel, apparently rough, and of a very dark colour, in which latter particular all the accounts coincide.

A ship-master, and two of his men, being in a boat, approached this monstrous animal to within the short distance of thirty feet. They describe it as being of the serpent form, its head resembling that of a land snake, and very large, of the size of a ten gallon keg. It darted out its tongue, the extremity of which resembled a fisherman's harpoon, to the extent of two feet, raising it perpendicularly and again letting it fall. Over each of the eyes, which were very bright, was a bunch. Its body was apparently about two feet and a half in circumference. Its motion was at the rate of twelve or fourteen miles in an hour, much swifter than that of a whale, or any other fish, and vertical, but steady.

Another ship-master attests that he saw the serpent three times, twenty or thirty persons being present, at the distance of about 150 yards. Its apparent length was 80 or 90 feet, and its size that of a half-barrel. It had joints, or bunches, from head to tail; its head, which was raised two feet above the water, resembling that of a rattlesnake, and of the size of a horse's head. Its mouth was open about ten inches. Its body was of a dark chocolate colour, and rough and scaly. In turning short and quick, the first part of the curve it made resembled the link of a chain; but when the

head came parallel with the tail, they appeared near together; when on the surface of the water, its motion was slow, the animal at times playing about in circles, and at others moving nearly straight forward. In disappearing, it apparently sunk directly down.

The other depositions were seven in number, three by merchants, one by a ship-master, one by a ship-carpenter, and two by mariners. One of them describes the tongue of the animal as resembling a prong, or spear, elevated about twelve inches, six inches in circumference, and terminating in a small point. The body appeared to be jointed, round, and about the size of that of a man. The other accounts agree in the foregoing particulars, all testifying the enormous length of the animal, which in some instances they estimate at 70 feet; and the extreme rapidity of its motion through the water. This motion was vertical, like that of the caterpillar. The ship carpenter, Matthew Gaffney, being in a boat on the 14th of August, and within thirty feet of the animal, discharged his piece, carrying a large ball, at its head, which he thought he struck. The creature turned immediately towards the boat, as if to approach it; but sunk down, and went directly under it, again making its appearance at about one hundred yards distance. *It did not turn down like a fish, but appeared to settle directly down like a rock.*

The society having been informed that an animal resembling the above had been seen at Plymouth, a sea-port belonging to the United States, two or three years before, procured the following testimony on oath from a ship-master residing there.

On the 20th of June, 1815, this deponent, Elkanah Finney, was suddenly called to witness a strange appearance in the cove next his house. By the aid of his glass, he was satisfied in a moment that it was some aquatic animal, with the form, motion, and appearance of which he had been hitherto unacquainted. It moved, at the distance of a quarter of a mile from the shore, with great rapidity towards the north, being then apparently about thirty feet in length; but in again making towards the cove, it displayed a much greater length, not less in the deponent's opinion, than a hundred feet. It approached him in a southerly direction, very rapidly, until it came in a line with him, when it

stopped, and lay entirely still on the surface of the water. "I had then," observes the deponent, "a good view of the animal through my glass, at the distance of a quarter of a mile. His appearance in this situation was like a string of buoys. I saw perhaps thirty or forty of these protuberances or bunches, which were about the size of a barrel. The head which tapered off to the size of a horse's head, appeared to be about six or eight feet long, and where it was connected with the body was a little larger than the latter. I could not discern any mouth; but what I supposed to be his under jaw had a white stripe extending the whole length of the head just above the water. While he lay in this situation, he appeared to be about a hundred or a hundred and twenty feet long. The body appeared to be of an uniform size. I saw no part of the animal which I supposed to be a tail, and thought therefore that he did not discover to me his whole length. His colour was a deep brown or black. I could not discover any eyes, mane, gills, or breathing holes. I did not see any fins or legs. The animal did not utter any sound, and did not appear to notice any thing, but remained still and motionless for five minutes or more. The wind was light, with a clear sky, and the water quite smooth. He then moved to the southward, but not with as rapid a motion as before. The next morning at eight o'clock, it being quite calm, I again saw the animal about a mile to the northward of my house, down the beach: he did not display so great a length as the night before, perhaps not more than twenty or thirty feet. He often disappeared, and was gone five or ten minutes under water. I thought he was diving or fishing for his food.—He remained nearly in the same situation, and thus employed, for nearly two hours. I then saw him moving off, in a northern direction, towards the light-house. I could not determine whether his motion was up and down, or to the right and left; but his quickest motion was very rapid; I should suppose at the rate of fifteen or twenty miles an hour. Mackarel, herrings, and other bait fish, abound in the cove where the animal was seen."

This deposition is considered as impartial and unbiassed, it agreeing uniformly with the deponent's first declarations in 1815. When made, he had not perused the testimonials procured at Cape Ann; and having been engaged from his

youth in foreign voyages, and frequently seen whales, and almost every species of fish, his testimony must be allowed to have great weight.

In corroboration of the existence of the Sea Serpent on the coast of North America, the testimony of the Rev. Mr. Cummings, a clergyman employed in the Missions of the district of Maine, is adduced by the Society. His relation, made in the month of June, 1809, was taken down in writing by a friend. It states that in Penobscot bay, a Sea Serpent, supposed to be about sixty feet in length, and of the size of a sloop's mast, had been occasionally seen within the last thirty years. Mr. Cummings being with a party, in a boat twenty-three feet in length, the animal approached to within fifteen rods, and was judged to be about three times that length. He held his head, which resembled that of a common snake, flattened, and about the size of a pail, five feet out of the water. About the head and neck the colour was a bluish green; but the tint of the body could not be determined, on account of the rippling of the water. The British, Mr. Cummings observed, saw him in their expedition to Bagaduse, and estimated his length at 300 feet, which he thought an exaggeration. He added that this animal had been frequently seen by the inhabitants of Fox and Long Islands, Mount Desert, &c.

In the communication to the Society from which the above extract is made, there are two other testimonies, that of a Captain Lillis, who observed that he had seen off the coast, in 1809, a very singular fish, about forty feet long, which appeared more like an ordinary serpent than a fish, holding his head erect, without a mane;—and that of a resident of one of the islands in the Bay of Penobscot, who declared that he had often seen a marine monster of this description, which was as large as a sloop's boom, and about sixty or seventy feet long. He asserted that about the year 1780, as a schooner was lying at the mouth of the river, or in the bay, one of these enormous creatures leaped over it between the masts: the men ran into the hold for fright, and the weight of the serpent sunk the vessel, which was of eighteen tons burthen, 'one streak,' or plank.

Extracts are given by the Society from the Natural History of Norway, by Pontoppidan, Bishop of Bergen, to show how much his account of the Sea Serpent on the

Norwegian coast agrees with the above depositions and statements. The following passage will suffice to evince this, with the difference, however, that the Norwegian Serpent is represented as much longer, and of a proportionate bulk. "Though one cannot," says the Bishop, "have an opportunity of taking the exact dimensions of this creature, yet all who have seen it are unanimous in affirming, as far as they can judge at a distance, that it appears to be the length of a cable, *i. e.* one hundred fathoms, or six hundred English feet; that it lies on the surface of the water, when it is very calm, in many folds; and that there are, in a line with the head, some small parts of the back to be seen above the surface of the water, when it moves or bends. These at a distance appear like so many casks or hogsheads floating in a line, with a considerable distance between them. Mr. Tuchsen, of Heroe, is the only one of the many correspondents I have, who informs me that he has observed the difference between the body and the tail of this creature, as to thickness. It appears that it does not, like the eel or land snake, taper gradually to a point, but that the body, which looks to be as big as two hogsheads, grows remarkably small at once where the tail begins. The head in all the kinds has a high and broad forehead, but in some a pointed snout, though in others that is flat, like that of a cow or horse, with large nostrils, and several stiff hairs standing out on each side, like whiskers. The accounts add, that the eyes of this creature are very large, of a blue colour, and looked like a couple of bright pewter plates. The whole animal is of a dark brown colour, but speckled and variegated with light streaks or spots, which shine like tortoise shell. Some say it sheds its skin like the land snake. The wind is so destructive to this creature, that it is never seen on the surface of the water but in the greatest calm; and the least gust of wind drives it immediately to the bottom again. It shoots through the water like an arrow from the bow, seeking constantly the coldest places. I have been informed by some of our seafaring men that a cable would not be long enough to measure the length of some of them, when they are observed on the surface of the water in an even line. They say those round lumps or folds sometimes lie one after another as far as a man can see."

The report of the Committee of the Linnæan Society adds: "We have seen and heard sundry other statements, of various authority, relating to similar animals, said to have been seen at sea by different persons; but do not insert them in our report, because we consider the foregoing testimony sufficient to place the existence of the animal beyond a doubt; and because they do not appear so minute and so well authenticated as the preceding documents."

About four weeks after the depositions, the substance of which has been given above, had been received, a young serpent of a remarkable appearance was brought from Gloucester to Boston, and exhibited as the progeny of the Great Sea Serpent. It had been killed in a meadow situated on the eastern shore of Cape Ann, within 150 paces of high water mark, by a planter, who, with a pitchfork, confined the animal against some loose rocks. He exhibited the most violent rage, biting himself twice, holding on, and shaking (to use the planter's expression) as one dog shakes another in fighting. His tail seemed likewise a weapon of defence; for he struck the end of it against the handle of the fork several times. His progressive movement was vertical, but slow, and was produced, first by contracting, and then by extending the body. When contracted, the animal was not more than a foot and a half in length; and the protuberances on his back were then at least three times as large as when he was extended.

The Committee of the Linnæan Society having inspected both the external and internal structure of this animal, which they name the Scoliophis Atlanticus, or flexuous serpent of the Atlantic, proceed to remark that it has the general form and external characters of a serpent, but is remarkably distinguished from all others of that class by a row of protuberances along the back, apparently formed by undulations of the spine. These protuberances are forty in number, and their size is proportioned to that of the body, at the places where they are respectively situated. Thus the body can be bent with facility upward and downward, a circumstance not common to other serpents. The whole length of the animal is 2 feet 11½ inches.

After a minute anatomical description of the Scoliophis Atlanticus (the young serpent) the Committee discuss the question whether it is to be so identified with the Great

Sea Serpent, as to be considered of the same species. The appearance, they remark, at nearly the same time and place, of two creatures agreeing with each other in certain important and conspicuous particulars, disagreeing in the most remarkable of these particulars with other animals of their class, and between whom no difference, but that of size, has been discovered, must naturally lead to a conjecture that they are of the same species. The appearances noticed in the depositions, relative to the great serpent, bating a few exceptions, agree with, and are accounted for, by a structure like that of the Scoliophis. The protuberances seen above the water might have been produced in two ways: by bunches on the back projecting out of the water; or by vertical undulations of the body when in motion. The supposition that both these appearances have been presented at different times, is the most satisfactory mode of accounting for the variety of testimony with regard to the number, size, and distance of these protuberances. The other facts stated in relation to the form and general arrangement of colours in the large serpent, apply sufficiently well to the Scoliophis. The shape of the head and proportion of the eye—the protuberance on the side of the head, just above the eye—the form of the mouth—the distance from the head to the commencement of the protuberances—the brown colour of the body, and the whitish colour of the under part of the head and neck—the disappearance of bunches from what was supposed to be the navel toward the tail—the tapering of the body toward the tail—its roundness, and great flexibility, are all points of the closest resemblance. These coincidences cannot be the effect of design, since all the depositions from Gloucester, relative to the Great Serpent, were in the hands of the Committee before the Scoliophis was discovered.

The prong or spear seen near the head of the former, when in motion, was probably the tongue. The shape of a harpoon, ascribed to that organ, was doubtless an optical illusion, occasioned by its rapid vibration; and this, it is well known, is not the first instance of such a deception. The structure of the Scoliophis is besides well suited to a residence in the water, being capable of various and complicated motions. It bends horizontally, as did the Great Serpent, in the act of turning; it bends vertically, as

that animal is supposed to do in the act of swimming; and it might assume any compound and intermediate motion, that would be most effectual in propelling it through the water.

Supposing, therefore, the species of the two serpents to be the same, it is not improbable that the one is the progeny of the other. The Colubri without fangs, the tribe most nearly resembling the Scoliophis, are said by naturalists to be generally, if not always, oviparous; to deposit their eggs in the sand in the spring, or in the end of summer; and to abandon them. These eggs are hatched by the heat of the sun often in less than a month. It should be remarked that the large serpents described in the accounts and depositions, were seen near the shore, and, with one exception, in the month of August only.

In reply to the three principal objections which may be made against the specific identity of the two animals; and, first, their disproportionate size. This is not apparently greater than is found between the young and full grown individuals of some other animals, among which may be cited the Boa Constrictor. Secondly, that the one was seen only in the water, and the other on land. This objection is lessened when it is recollected that the eggs of amphibious animals are deposited on land. The large serpent may have visited the shore in the night, or at other times. That it was an amphibious animal, dependent on respiration, is rendered probable by its general structure, and by its frequenting the surface of the water, often with its head elevated above it. The small serpent was found near the salt water, in a place over which the sea breaks in stormy weather. Supposing it a young animal, it might have remained in the place where it was hatched, or it might have occasionally resorted to the shore from the water. It could not be expected to venture far from the shore, until its increased size should afford it some security from becoming a prey to larger animals of the ocean. Lastly, the circumstance that not any evidences of immaturity were observed in the Scoliophis might be considered as a source of a third objection, if it were not well known that, as serpents generally abandon their eggs, the young are perfect in all their parts, and capable of providing for their own subsistence, immediately on their being hatched.

On the whole, the Committee observe, as these two an-

imals agree in so many conspicuous, important, and peculiar characters, and as no material difference has been yet clearly pointed out, excepting that of size, the Society will probably feel justified in considering them individuals of the same species, and entitled to the same name, until a more close examination of the Great Serpent shall have disclosed some difference of structure, important enough to constitute a specific distinction.

A postscript contains a communication from Long Island, stating that, on the 5th of October, 1817, the Sea Serpent had been seen in the sound. At the distance of half a mile from the shore, a long, rough, dark-looking body was observed, making a rapid progress towards New York, against a brisk breeze and a strong ebb tide. The observers were soon convinced that it was a living animal. His head did not at first appear more elevated above the water than the ridges or bumps on his back; but when he was afterwards seen, nearly in the middle of the Sound, his body, owing to the increased velocity with which he moved, became more depressed, and his head greatly elevated. He was distinctly seen for about ten minutes, during which short space it was estimated that his progress was not less than six or seven miles. His back, 40 or 50 feet of which appeared above the surface of the water, was irregular, uneven, and deeply indented. The general description of the animal, in this statement, agrees with those already given; but it is said that the extreme rapidity with which he moved, created a swell not unlike that of a boat towed rapidly at the stern of a vessel.

THE RATTLESNAKE.

THE genus CROTALUS, OF RATTLESNAKE, affords the most signal examples of the powerfully destructive poison with which some of the serpent tribe are furnished; instances having frequently occurred in which the bite of these snakes has, in the space of a few minutes even, proved fatal to man.

It was not until the discovery of the western hemisphere, that naturalists beheld with amazement a reptile of the most fatal nature, furnished, agreeably to their conception, as if by a peculiar institution of Providence, with an instrument capable, in general, of warning mankind of their danger on

too near an approach. This is, however, treated by Dr. Mead as a vulgar error; and he very sensibly observes, that "all the parts of animals are made either for the preservation of the individual, or for the propagation of its species; this before us is for the service of the individuals. This snake lives chiefly on squirrels and birds, which a reptile can never catch without the advantage of some management to bring them within his reach. The way is this. The snake creeps to the foot of a tree, and by shaking his rattle, awakens the little creatures which are lodged in it. They are so frightened at the sight of their enemy, who fixes his lively piercing eyes upon one or other of them, that they have not the power to get away, but leap from bough to bough, till they are quite tired, and at last falling to the ground, are snapped into his mouth. This is, by the people of the country, called the charming of squirrels and birds." This opinion of Dr. Mead is supported by Dr. Barton of Philadelphia, who, in a memoir on the supposed fascinating power of the rattlesnake, imagines the whole to be nothing more than the fluttering of old birds in defence of their young, and which are themselves occasionally caught by the rattlesnake, in consequence of too near an approach.

This species is in general from three to five feet in length; but one is described by Catesby as measuring eight feet. This traveller observes, that "it is the most inactive of all snakes, and has the slowest motion, never being the aggressor, except in what it preys upon; for unless it is disturbed, it will not bite." It is of a yellowish-brown colour, marked throughout its whole length with several transverse and somewhat irregular *fasciæ* of deep brown. From the head to some distance down the neck run two or three longitudinal stripes of the same colour. The head is large, flat, and covered with small scales; the rest of the upper parts with moderate large oval ones, all strongly furnished with a prominent line down the middle: the under parts are of a dingy yellowish-brown colour, marked with numerous dusky variegations and freckles. At the extremity of the tail is situated the rattle, consisting of several hard, dry, horny processes, which, on the least disturbance or irritation, is elevated and shaken in such a manner as to cause a strong and brisk rattling sound.

The rattlesnake is a viviparous animal, and is said to practise the same extraordinary mode of preserving its young from danger as is ascribed to the viper in Europe, that is, by receiving them into its mouth and swallowing them. M. de Beauvois, in the relation of his travels, declares that he was himself an eye-witness of this process. Happening, in his walk, to disturb a large rattlesnake, the creature immediately coiled itself up, opened its jaws, and instantly five small ones, which were lying near it, rushed into its mouth. He retired, and watched the snake, and in a quarter of an hour saw her again discharge them. He then approached the second time, when the young retired into its mouth with greater celerity than before, and the snake immediately moved off among the grass, and escaped.

THE COBRA DE CAPELLO.

THE following interesting account of this very curious snake, a native of India, is extracted from Forbes' Oriental Memoirs, a work the merits of which cannot be sufficiently praised.

"The Cobra de Capello, or hooded-snake (coluber naja), called by the Indians the naag, or nagao, is a large and beautiful serpent; but one of the most venemous of all the coluber class; its bite generally proves mortal in less than an hour. It is called the hooded-snake, from having a curious hood near the head, which it contracts or enlarges at pleasure; the centre of this hood is marked in black and white like a pair of spectacles, whence it is also named the spectacle snake.

"Of this genus are the dancing-snakes, which are carried in baskets throughout Hindostan, and procure a maintenance for a set of people, who play a few simple notes on the flute, with which the snakes seem much delighted, and keep time by a graceful motion of the head, erecting about half their length from the ground, and following the music with gentle curves, like the undulating lines of a swan's neck. It is a well attested fact, that when a house is infested with these snakes, and some other of the coluber genus, which destroy poultry and small domestic animals, as also by the larger serpents of the boa tribe, the musicians are sent for; who, by playing on a flagelet, find out their hiding-places, and charm them to destruction: for no sooner do the snakes

hear the music than they come softly from their retreat, and are easily taken. I imagine these musical snakes were known in Palestine, from the Psalmist comparing the ungodly to the deaf adder, which stoppeth her ears, and refuseth to hear the voice of the charmer, charm he never so wisely.

"When the music ceases the snakes appear motionless; but if not immediately covered up in the basket, the spectators are liable to fatal accidents. Among my drawings is that of a Cobra de Capello, which danced for an hour on the table while I painted it; during which I frequently handled it, to observe the beauty of the spots, and especially the spectacles on the hood, not doubting but that its venomous fangs had been previously extracted. But the next morning my upper servant, who was a zealous Mussulman, came to me in great haste, and desired I would instantly retire, and praise the Almighty for my good fortune; not understanding his meaning, I told him that I had already performed my devotions, and had not so many stated prayers as the followers of his prophet. Mahomed then informed me, that while purchasing some fruit in the bazar, he observed the man who had been with me the preceding evening, entertaining the country people with his dancing snakes; they, according to their usual custom, sat on the ground around him; when, either from the music stopping too suddenly, or from some other cause irritating the vicious reptile which I had so often handled, it darted at the throat of a young woman, and inflicted a wound of which she died in about half an hour. Mahomed once more repeated his advice for praise and thanksgiving to Alla, and recorded me in his calendar as a lucky man."

THE CERASTES, OR HORNED SNAKE.

This curious species is a native of many parts of Africa, and is also frequent in Egypt, Syria, and Arabia. It is about two feet in length, and is distinguished by a pair of horns, or curved processes, situated above the eyes, and pointing forwards: these horns have not any thing analogous in their structure to the horns of quadrupeds, and are by no means to be considered in the light of offensive or defensive weapons: they increase however the natural antipathy so generally felt against the serpent tribe, and give the animal a more than ordinary appearance of malignity. Its bite is

much to be dreaded, since, exclusive of the general danger of treading accidentally on this reptile, and thus irritating it unawares, it possesses a propensity to spring suddenly to a considerable distance, and assail without provocation those who happen to approach it. "When," Mr. Bruce observes, "he inclines to surprise any one, the Cerastes creeps with his side towards the person, and his head averted, till judging his distance, he turns round, springs upon him, and fastens on the part next to him."

On the subject of the incantation of serpents this celebrated traveller remarks as follows: "There is not any doubt of its reality: the scriptures are full of it; and those who have been in Egypt have seen as many different instances as they chose. Some have suspected that it was a trick, and that the animals so handled had been first trained, and then disarmed of the power of hurting; and, fond of the discovery, have rested themselves upon it, without experiment, in the face of all antiquity. But I will not hesitate to aver, that I have seen at Cairo (and this may be seen daily, without trouble or expense) a man who came from above the catacombs, where the pits of the mummy birds are kept, who has taken a Cerastes with his naked hand, from a number of others lying at the bottom of a tub, has put it upon his bare head, covered it with the common red cap he wears, then taken it out, put it on his breast, and tied it about his neck like a necklace; after which it has been applied to a hen, and bit it, which has died in a few minutes; and, to complete the experiment, the man has taken it by the neck, and, beginning at the tail, has eaten it, as one would do a carrot, or a stock of celery.

"However lively the snake may have been before, when he is seized by any of these barbarians, he seems as if taken with sickness and feebleness, frequently shuts his eyes, and never turns his mouth towards the arm of the person who holds him. On their being questioned how they are exempted from its attack, the gravest and most respectable among the Egyptians reply that they were born so; while the lower sort talk of enchantments by words and by writing. They all pretend to prepare any person by remedies, that is, by decoctions of herbs and roots. Be this as it may, the records of history attest, that where any country has been remarkably infested by serpents, there the people

have been screened by a secret of some kind. Thus it was with the Psylli and Maronides of old."

"Tame at whose spell the charm'd Cerastes lay."

GREAT VIPER OF MARTINIQUE.

THIS formidable reptile is peculiar to the islands of Martinique, St. Lucie, and Beconia, and has never been traced to the American continent. On account of its triangular head, resembling that of a spear, it has been named by the French naturalist TRIGONOCEPHALUS: when full grown it is nearly eight feet in length, and its bite is highly dangerous. Its agility is, as well as its mode of darting, very remarkable: it rolls the body in four circles, one upon another, the circumvolutions of which incline all at once at the will of the animal, so as to throw the whole mass forward five or six feet. After the manner of the crested or hooded snake, it can raise itself upright on its tail, and thus attain the height of a man; at the same time that, by means of large scales, laid over each other, with which the belly is covered, this serpent, like the adder, can climb large trees, and creep among the branches, in order to reach the birds' nests, whose young he devours, and in which he has often been found coiled up.

FASCINATING POWER OF SNAKES.

A REMARKABLE instance of the fascinating power of snakes is given in Lichtenstein's travels in Southern Africa. In rambling in the fields near Cape Town, he saw, at the brink of a ditch, a large snake in pursuit of a field mouse. The poor animal was just at its hole, when it seemed in a moment to stop, as if unable to proceed, and without being touched by the snake, to be palsied with terror. The snake had raised its head over him, had opened its mouth, and seemed to fix its eyes stedfastly upon him. Both remained still awhile; but as soon as the mouse made a motion, as if to flee, the head of the snake instantly followed the movement, as if to stop his way. This sport lasted four or five minutes, till the author's approach put an end to it: the snake then snapped up his prey hastily, and glided away with it to a neighbouring bush. "As I had," he observes, "heard a great deal of this magic power in the snake over smaller animals, it was very interesting to me to see a spe-

cimen of it. I think it may be made a question, however, whether the poisonous breath of the reptile might not really have had the effect of paralysing the limbs of the mouse, rather than that its inability to move proceeded either from the fixed eye of the snake, or the apprehension of inevitable death. It is remarkable, and very certain, that serpents will sport with their prey, as cats do, before they kill it."

This author notices several peculiarities of the snakes of South Africa. A very rare description of serpent is there called the SPURTING SNAKE. It is from three to four feet long, of a black colour, and has the singular property, as the colonists assert, that, when it is attacked, it spurts out its venom, and knows how to give it such a direction as to hit the eyes of the person making the attack. This is followed by violent pain, and by so great an inflammation, that it frequently occasions the entire loss of the sight.—The POF-ADDER, one of the most poisonous species, is distinguishable by a disproportionate thickness, and by a body handsomely spotted with black and white spots on a brownish ground. It has this peculiarity, that, when it is enraged, it swells out its neck to a very great size. One which was caught, measured in length about an ell and a half, and was about six inches round in its greatest circumference.—One of the species, called the TREE SNAKE, was caught while in the act of climbing up the wall of a farmhouse, to take the swallows which had their nests under the roof. This snake is extremely adroit at climbing, and is, therefore a terrible enemy to small birds. Its bite is extremly venomous, and is considered as mortal. The one here noticed, measured six feet in length, with a black back, and greyish belly. In the belly were found six half-digested young swallows.—The LEMON SNAKE measures about five feet in length, and has a skin of a fine lemon-colour, regularly spotted with black.

THE ELEPHANT.

How instinct varies in the grov'lling swine,
Compar'd, half-reasoning elephant, with thine!
'Twixt that, and reason, what a nice barrier!
For ever separate, yet for ever near! POPE.

THE largest elephants are from ten to eleven feet in height: some are said to exceed it; but the average is eight or nine

feet. They are fifty or sixty years before they arrive at their full growth; and their natural life is about one hundred and twenty years. Their price increases with their merit during a course of education. Some, for their extraordinary qualities, become in a manner invaluable; when these are purchased, no compensation induces a wealthy owner to part with them.

The skin of the elephant is generally a dark grey, sometimes almost black; the face frequently painted with a variety of colours; and the abundance and splendour of his trappings add much to his consequence. In India the Mogul princes allow five men and a boy to take care of each elephant; the chief of them, called the mahawut rides upon his neck to guide him; another sits upon the rump, and assists in battle; the rest supply him with food and water, and perform the necessary services. Elephants bred to war, and well disciplined, will stand firm against a volley of musquetry, and never give way unless severely wounded. One of these animals has been seen with upwards of thirty bullets in the fleshy parts of his body, perfectly recovered from his wounds. All are not equally docile, and when an enraged elephant retreats from battle, nothing can withstand his fury: the driver having no longer a command, friends and foes are involved in undistinguished ruin.

The elephants in the army of Antiochus were provoked to fight by shewing them the blood of grapes and mulberries. The history of the Maccabees informs us, that "to every elephant they appointed a thousand men, armed with coats of mail, and five hundred horsemen of the best; these were ready at every occasion; wherever the beast was, and whithersoever he went, they went also; and upon the elephants were strong towers of wood, filled with armed men, besides the Indian that ruled them."

Elephants in peace and war know their duty, and are more obedient to the word of command than many rational beings. It is said they can travel, on an emergency, two hundred miles in forty-eight hours; but will hold out for a month, at the rate of forty or fifty miles a day, with cheerfulness and alacrity. "I performed," observes Forbes in his Oriental Memoirs, "many long journeys upon an elephant: nothing could exceed the sagacity, docility, and affection of this noble quadruped. If I stopped to enjoy

a prospect, he remained immoveable until my sketch was finished; if I wished for ripe mangoes growing out of the common reach, he selected the most fruitful branch, and breaking it off with his trunk, offered it to the driver for the company in the houdah, accepting of any part given to himself with a respectful salem, by raising his trunk three times above his head, in the manner of the oriental obeisance, and as often did he express his thanks by a murmuring noise. When a bough obstructed the houdah, he twisted his trunk around it, and, though of considerable magnitude, broke it off with ease, and often gathered a leafy branch, either to keep off the flies, or as a fan to agitate the air around him, by waving it with his trunk; he generally paid a visit at the tent-door during breakfast, to procure sugar-candy or fruit, and be cheered by the encomiums and caresses he deservedly met with: no spaniel could be more innocently playful, nor fonder of those who noticed him, than this docile animal, which on particular occasions appeared conscious of his exaltation above the brute creation."

However surprising may be the docility of this noble animal, when tamed, its sagacity, in a savage state even, is a subject of still greater wonder, as is evidenced by the following narrative extracted from Lichtenstein's travels in Southern Africa. Two individuals, named Muller and Prince, being engaged, in the Caffre territory, where these animals abound, in an elephant hunt, discovered the footsteps of a very large elephant, and soon espied the animal himself on the declivity of a naked and widely outstretched hill. It is a rule, when an elephant is thus found, to endeavour to get above him on the hill, to the end that, in case of necessity, the hunter may flee to the summit, whither the animal, on account of the unwieldiness of its body, cannot follow him fast. This precaution was neglected by Prince, who shot too soon, while they were yet at too great a distance, and the elephant on higher ground than himself and his companion. The wounded animal rushed down towards them, while they endeavoured to push their horses on, and gain the brow of the hill. Being able, on favorable ground, to run as fast as a horse, he soon came up with them, and struck with his tusk at Muller's thigh, he being the nearest of the two fugitives. Muller now considered

his fate as inevitable, as he endeavoured in vain to set his almost exhausted horse into a gallop, and saw the animal, after giving a violent snort, raise his powerful trunk above his head. It was not, however, on himself, but on his companion, that the stroke fell; and in an instant he saw him snatched from his horse, and thrown up into the air. Scarcely in his senses, he continued his flight, and only in some degree recovered himself by finding Prince's horse running by his side without a rider: then looking back, he saw his unfortunate friend on the ground, and the elephant stamping upon him with the utmost fury. He was now convinced, not without the greatest astonishment, that the sagacious animal had distinguished which of the two it was who wounded him, and wreaked his whole vengeance upon him alone. Muller, on this, went in search of the rest of the party, that they might collect the mangled remains of their companion, and bury them; but they were soon put to flight by the elephant rushing again from a neighbouring thicket, to vent his wrath once more upon the corpse, already so dreadfully mangled. While he was busied in doing this, however, he was attacked by the dispersed hunters, and sacrificed to the manes of his unfortunate victim.

The contrivances for taking elephants are various; but the most curious are those employed by the natives of Ceylon, where the finest race of these animals is found. They sometimes surround the woods in bands, and drive with lighted torches, amid the clamour of trumpets, the discharge of fire-arms, and noises of every description, the elephants which inhabit them, till they are at length entrapped into a particular spot surrounded with palisades, so as to prevent all escape. At other times a kind of decoy, or female elephant, is sent out in order to induce some of the males to pursue her, who are by that means secured. When a wild elephant is taken, it still remains to reduce it to a quiet state, and to tame it, in order to its being made useful: this is effected by throwing ropes round the legs and body, which are well secured; and two tame elephants, properly instructed, are placed on each side. The captive animal finds himself gradually so fatigued by his ineffectual struggles, and so much soothed by the caresses occasionally given by the trunks of the tame elephants, by the food from

time to time presented to him, and the water with which he is refreshed by its being poured over him, that in the space of a few days, unless more than unusually untractable in his nature, he becomes completely tame, and is placed with the rest of the domesticated troop. Sometimes, in order more effectually to subdue them, the elephants are deprived of sleep for a considerable time.

The anecdotes recording the sagacity, and also the amiable qualities of the elephant, are numerous. Of these the following are selected as highly interesting. In Delhi, an elephant passing along the streets, put his trunk into a tailor's shop, where several persons were at work. One of them pricked the end of his trunk with his needle; the beast passed on; but at the next dirty puddle filled his trunk with water, returned to the shop, and spurting it among those who had offended him, spoiled their work.—At Adsmeer, an elephant which often passed through the bazar, or market, as he went by a certain herb-woman, always received from her a mouthful of greens: at length he was seized with one of his periodical fits of rage, broke his fetters, and, running through the market, put the croud to flight, and, among others, this woman, who, in her haste, forgot a little child she had brought with her. The animal recollecting the spot where his benefactress was wont to sit, took up the infant gently on his trunk, and placed it in safety on a stall before a neighbouring house.—At the same place, another elephant, in his madness, killed his *cornac*, or governor: the wife, witnessing the misfortune, took her two children, and flung them before the elephant, saying, "now you have destroyed their father, you may as well put an end to their lives and mine." It instantly stopped, relented, took the eldest of the boys, placed him on his neck, adopted him for his governor, and never afterwards would permit any other person to mount him.—A painter was desirous of drawing the elephant kept in the menagerie at Versailles, in an uncommon attitude, namely, that of holding his trunk raised up in the air, with his mouth open. The painter's boy, in order to keep the animal in this posture, threw fruit into his mouth; but as the lad frequently deceived him, and made an offer only of throwing the fruit, he grew angry; and, as if he had known that the painter's intention of drawing him was

the cause of the affront thus offered, instead of avenging himself on the lad, he turned his resentment on the master, and taking up a quantity of water in his trunk, threw it on the paper on which the painter was drawing, and spoiled it.

THE ORANG OUTANG.

This singular animal, likewise called the satyr, great ape, or man of the woods, which has, on account of its near approximation to the human species, so strongly excited the attention of naturalists, is a native of the warmer parts of Africa and India, where it resides principally in woods, on the fruits of which it feeds, like the other species of the *simia* race. Such of these animals as have been imported into Europe have rarely exceeded the height of two or three feet, and have therefore been supposed to be young; those full grown being said to be at least six feet in height. The general colour of the orang outang is a dusky brown: the face is bare; the ears, hands, and feet, nearly similar to the human; and the whole appearance such as to exhibit the most striking approach to the human figure. The likeness, however, is only a general one, and the structure of the hands and feet, when examined with an anatomical precision, seems to prove that the animal was principally designed by nature for the quadruped mode of walking, and not for an upright posture, which is only occasionally assumed, and which, in those exhibited to the public, is, perhaps, rather owing to instruction than truly natural. Buffon, indeed, makes it one of the distinctive characters of the real or proper apes, of which the orang outang is the chief, to walk erect on two legs only; and it must be granted that these animals support an upright posture much more easily and readily than most other quadrupeds, and may probably be often seen in this attitude even in a state of nature.

The manners of the orang outang, when in captivity, are gentle, and perfectly devoid of that disgusting ferocity so conspicuous in some of the larger baboons and monkies. It is mild and docile, and may be taught to perform, with dexterity, a variety of actions in domestic life. Thus it has been seen to sit at table, and, in its manner of feeding and general behaviour, to imitate the company in which it was

placed; to pour out tea, and drink it without awkwardness or restraint; to prepare its bed with exactness, and compose itself to sleep in a proper manner. Such are the actions recorded of one which was in London, in 1738.

The orang-outang described by Buffon was mild, affectionate, and good-natured. His air was melancholy, his gait grave, his movements measured, his disposition gentle, and very different from those of other apes. He had neither the impatience of the Barbary ape, the maliciousness of the baboon, nor the extravagance of the monkey tribe. It may be alledged, observes this writer, that he had had the benefit of instruction; but the other apes I shall compare with him were educated in the same manner. Signs and words alone were sufficient to make our orang-outang act; but the baboon required a cudgel, and the other apes a whip; for none of them would obey without blows. I have seen this animal present his hand to conduct the persons who came to visit him, and walk as gravely along with them as if he had formed a part of the company. I have seen him sit down at table, unfold his napkin, wipe his lips, use a spoon or fork to carry the victuals to his mouth, pour his liquor into a glass, and make it touch that of a person who drank along with him. When invited to take tea, he brought a cup and a saucer, placed them on the table, put in sugar, poured out the tea, and allowed it to cool before he drank it. All these actions he performed without any other instigation than the signs or verbal orders of his master, and often of his own accord. Far from doing an injury to any one, he even approached company with circumspection, and presented himself as if he wished to be caressed.

Doctor Tyson, who, about the close of the seventeenth century, gave a very exact description of a young orang-outang, then exhibited in the metropolis, observes that, in many of its actions, it seemed to display a very high degree of sagacity, and was the most gentle and affectionate creature imaginable. Those whom it had known on shipboard it embraced with the greatest tenderness, opening their bosoms, and clapping its hands around them; and although several monkies had been embarked, still it was observed that, during the passage to England, it would never associate with them, and, as if nothing akin to them, would carefully avoid their company.

But however docile and gentle the orang-outang may be, when taken young, and instructed, it is said to be possessed of great ferocity in its native state, and is considered as a dangerous animal, capable of readily overpowering the strongest man. Its swiftness is equal to its strength, and for this reason it is but rarely to be obtained in its full-grown state, the young alone being taken.

The orang-outang now exhibiting at Exeter Change, is a native of Borneo, and is remarkable, not only on account of its extreme rarity, but as possessing, in many respects, a strong resemblance to man. What is technically denominated the cranium, is perfectly human in its appearance; the shape of the upper part of the head, the forehead, the eyes (which are dark and full), the eye-lashes, and, indeed, every thing relating to the eyes and ears, differing in no respect from man. The hair of his head, however, is merely the same which covers his body generally. The nose is very flat,—the distance between it and the mouth considerable; the chin, and, in fact, the whole of the lower jaw, is very large, and his teeth, twenty-six in number, are strong. The lower part of his face is what may be termed an ugly, or caricature, likeness of the human countenance. The position of the scapulæ, or shoulder-blades, the general form of the shoulders and breasts, as well as the figure of the arms, the elbow joint especially, and the hands strongly continue the resemblance. The metacarpal, or that part of the hand immediately above the fingers, is somewhat elongated; and, by the thumb being thrown a little higher up, nature seems to have adapted his hand to his mode of life, and given him the power of grasping more effectually the branches of trees. The fingers, both of the hands and feet, have nails exactly like those of the human race, with the exception of the thumb of the foot, which is without a nail.

He is corpulent about the abdomen, or, to employ the common phrase, rather pot-bellied, looking like one of those figures of Bacchus often seen riding on casks: but whether this is his natural appearance when wild, or acquired since his introduction into new society, and by indulging in a high style of living, it is difficult to determine.

His thighs and legs are short and bandy, the ankle and heel like the human; but the fore-part of the foot is composed of toes, as long and as pliable as his fingers, with a

thumb a little situated before the inner ankle; this conformation enabling him to hold equally fast with his feet as with his hands. When he stands erect, he is about three feet high, and he can walk, when led, like a child; but his natural locomotion, when on a plain surface, is supporting himself along at every step, by placing the knuckles of his hands upon the ground.

His natural food seems to be all kinds of fruits and nuts; but when he was embarked on board the Cæsar, the vessel which brought him to England, Mr. Mc Leod observes in his narrative already cited, he ate biscuit, or any other sort of bread, and sometimes animal food. He drank grog, and even spirits if given to him; and has been known repeatedly to help himself in this way: he was also taught to sip his tea or coffee: and since his arrival in England, has discovered a taste for a pot of porter. His usual conduct while on board was not mischievous, and chattering like that of monkies in general: but he had rather a grave and sedate character, and was much inclined to be social, and on good terms with every body. He made no difficulty, however, when cold or inclined to sleep, in supplying himself with any jacket he found hanging about, or in stealing a pillow from a hammock, in order to lie more soft and comfortably.

Some times, when teazed by shewing him something to eat, he would display, in a very strong manner, the human passions, following the person whining and crying, throwing himself off on his back, and rolling about apparently in a great rage, attempting to bite those near him, and frequently lowering himself by a rope over the ship's side, as if pretending to drown himself; but when he came near the water's edge, he always reconsidered the matter, and came on board again. He would often rifle and examine the pockets of his friends in quest of nuts and biscuits, which they sometimes carried for him. He had a great antipathy to the smaller tribe of monkeys, and would throw them overboard if he could; but in his general habits and dispositions there was much docility and good nature, and, when not annoyed, he was extremely inoffensive.

THE BEAVER.

Of all quadrupeds the Beaver possesses the greatest degree of natural and instinctive sagacity in constructing its habitation; preparing, in concert with others of its own species, a kind of arched caverns or domes, supported by a foundation of strong pillars, and lined or plaistered internally with a surprising degree of neatness and accuracy.

The AMERICAN, or, as they are called, the ASSOCIATED and CIVILIZED BEAVERS, unite in society in the months of June and July, arriving in numbers from all parts, and soon forming a troop of two or three hundred. If the waters near which they fix their establishment are flat, and do not rise above their ordinary level, as in lakes, they dispense with a bank or dam; but in rivers or brooks, where the waters rise and fall, they construct a bank, and by this artifice form a pond, or piece of water, which remains always at the same height. The bank traverses the river, from one side to the other like a sluice, and is often from eighty to a hundred feet long, by ten or twelve broad at the base. This pile, for animals of so small a size, appears to be enormous, and supposes an incredible labour: but the solidity with which the work is constructed is still more astonishing than its magnitude. The part of the river where they erect this bank is generally shallow. If they find on the margin a large tree which can be made to fall into the water, they begin with cutting it down, to form the principal part of their work. This tree is often thicker than the body of a man; but by gnawing at its foot with their four cutting teeth, they accomplish their purpose in a very short time, always contriving that the tree should fall across the river. They next cut the branches from the trunk, to make it lie level. These operations are performed by the whole community: while some are employed in gnawing the foot of the tree, others traverse the banks of the river, and cut down smaller trees, which they dress and cut to a certain length, to make stakes of them, and first drag them by land to the margin of the river, and then by water to the place where the building is carrying on. These piles they sink down, and interweave the branches with the larger stakes. While some are labouring in this manner, others

bring earth, which they plash with their fore-feet, and transport in such quantities, that they fill with it all the intervals between the piles. These piles consist of several rows of stakes, of equal height, all placed opposite to each other, and extend from one bank of the river to the other. The stakes facing the under part of the river are placed perpendicularly; but the rest of the work slopes upwards to sustain the pressure of the fluid, so that the bank, which is ten or twelve feet wide at the base, is reduced to two or three at the top.

The first great structure is made with a view to render their small habitations more commodious. These cabins, or houses, are built on piles near the margin of the pond, and have two openings, the one for going on the land, and the other to enable the beavers to throw themselves into the water. The form of these edifices is either oval or round, and their dimensions vary from four or five to eight or ten feet diameter. Some of them consist of three or four stories, and their walls are about two feet thick, raised perpendicularly on planks or plain stakes, which serve both for foundations and floors. They are built with amazing solidity, neatly plaistered both without and within, impenetrable to rain, and capable of resisting the most impetuous winds. The partitions are covered with a kind of stucco, as nicely plastered as if it had been executed by the hand of man. In the application of this mortar their tails serve for trowels, and their feet for plastering. They employ different materials, as wood, stone, and a kind of sandy earth, which is not subject to dissolution in water.

These most interesting animals labour in a sitting posture; and, besides the convenience of this situation, enjoy the pleasure of gnawing perpetually the wood and bark of trees, substances most agreeable to their taste; for they prefer fresh bark and tender wood to the greater part of their ordinary aliment. Of these provisions they lay up ample stores to support them during the winter; but they are not fond of dry wood, and make occasional excursions during the winter season for fresh provisions in the forests. They establish their magazines in the water, or near their habitations; and each cabin has its own, proportioned to the number of its inhabitants, who have all a common right to the store, and never pillage their neighbours. Some villages



No. 53.—Social African Birds' Nest.

are composed of twenty or twenty-five cabins; but such establishments are rare, and the common republic seldom exceeds ten or twelve families. The smallest families contain two, four, and six beavers; and the largest eighteen, twenty, and, it is alleged, sometimes thirty. They are almost always equally paired, there being the same number of females as of males. When danger approaches, they warn each other by striking the tail on the surface of the water, the noise of which is heard at a great distance, and resounds through all the vaults of their habitations. Each takes his part: some plunge into the lake, others conceal themselves within their walls, which can only be penetrated by the fire of heaven, or the steel of man, and which no animal will attempt eitherto open or overturn. They often swim a long way under the ice; and it is then that they are most easily taken, by at once attacking the cabin, and watching at a hole made at some distance, whither they are obliged to repair for the purpose of respiration.

Beside the associated beavers, there are others which lead a solitary life, and instead of constructing caverns, or vaulted and plastered receptacles, content themselves with forming holes on the banks of rivers. When taken young, the beaver may be readily tamed; and in that state appears to be an animal of a gentle disposition, but does not exhibit any symptoms of superior sagacity.

THE CHAMELEON.

No numbers can the varying robe express,
While each new day presents a different dress.

Few animals have been more celebrated by naturalists than the CHAMELEON, which is said to possess the power of changing its colour at pleasure, and of assimilating it to that of any particular object or situation. This, however, is to be recived with certain limitations, the change of colour it takes varying in degree, according to circumstances of health, temperature of weather, and other causes. It is a native of Africa and India, and has likewise been seen in the southern parts of Europe. It is harmless in its nature, and supports itself by feeding on insects, for which purpose the structure of the tongue is admirably adapted. It consists of a long missile body, furnished with a dilated, and somewhat

tubular tip, by means of which the animal seizes insects with great ease, darting out his tongue in the manner of a wood-pecker, and retracting it instantaneously with the prey on its tip. It can also support a long abstinence, and hence arose the popular idea of the chameleon being nourished by air alone.

A very interesting account of the chameleon is given by Forbes in his Oriental Memoirs. This great curiosity, he remarks, is so common in India, that it is found in every thicket. He describes with great accuracy, and in the following terms, one which he kept for several weeks.

"The Chameleon of the Concan, including the tail, is about nine inches long; the body only half that length, varying in circumference, as it is more or less inflated; the head, like that of a fish, is immovably fixed to the shoulders; but every inconvenience is removed by the structure of the eyes, which, like spheres rolling on an invisible axis, are placed in deep cavities, projecting from the head: through a small perforation in the exterior convexity appears a bright pupil, surrounded by a yellow iris, which, by the singular formation and motion of the eye, enables the animal to see what passes before, behind, or on either side; and it can give one eye all these motions, while the other remains perfectly still: a hard rising protects these delicate organs; another extends from the forehead to the nostrils: the mouth is large, and furnished with teeth, with a tongue half the length of the body, and hollow like an elephant's trunk; it darts nimbly at flies and other insects, which it seems to prefer to the aerial food generally supposed to be its sustenance. The legs are longer than usual in the lacerta genus; on the fore-feet are three toes nearest the body, and two without; the hinder exactly the reverse; with these claws it clings fast to the branches, to which it sometimes entwines itself by the tail, and remains suspended: the skin is granulated like shagreen, except a range of hard excrescences, or denticulations, on the ridge of the back, which are always of the same colour as the body; whereas a row of similar projections beneath continue perfectly white, notwithstanding any metamorphosis of the animal.

"The general colour of the chameleon, so long in my possession, was a pleasant green, spotted with pale blue: from this it changed to a bright yellow, dark olive, and a

dull green; but never appeared to such advantage as when irritated, or a dog approached it; the body was then considerably inflated, and the skin clouded like tortoise-shell, in shades of yellow, orange, green, and black. A black object always caused an almost instantaneous transformation; the room appropriated for its accommodation was skirted by a board painted black; this the chamelion carefully avoided; but if he accidentally drew near it, or if we placed a black hat in his way, he was reduced to a hideous skeleton, and from the most lively tints became black as jet; on removing the cause, the effect as suddenly ceased; the sable hue was succeeded by a brilliant colouring, and the body was again inflated.

THE BOTTLE-NESTED SPARROW.

THE BAYA, OF BOTTLE-NESTED SPARROW, is remarkable for its pendent nest, brilliant plumage, and uncommon sagacity. These birds are found in most parts of Hindostan; in shape they resemble the sparrow, as also in the brown feathers of the back and wings; the head and breast are of a bright yellow, and in the rays of a tropical sun have a splendid appearance, when flying by thousands in the same grove; they make a chirping noise, but have no song: they associate in large communities and cover extensive clumps of palmyras, acacias, and date trees, with their nests. These are formed in a very ingenious manner, by long grass woven together in the shape of a bottle, with the neck hanging downwards, and suspended by the other end to the extremity of a flexible branch, the more effectually to secure the eggs and young brood from serpents, monkeys, squirrels, and birds of prey. These nests contain several apartments, appropriated to different purposes: in one the hen performs the office of incubation; another, consisting of a little thatched roof, and covering a perch, without a bottom, is occupied by the male, who, with his chirping note, cheers the female during her maternal duties. The Hindoos are very fond of these birds, for their docility and sagacity: when young, they teach them to fetch and carry; and at the time the young women resort to the public fountains, their lovers instruct the baya

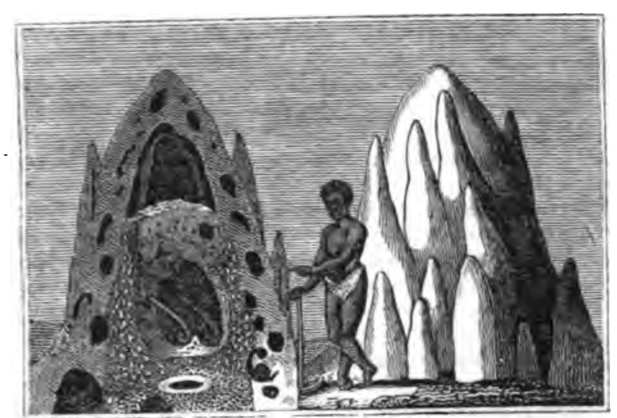
to pluck the tica, or golden ornament, from the forehead of their favourite, and bring it to their expecting master.

THE HUMMING BIRD.

There are not less than sixty-five species of this very curious bird, all of them remarkable for the beauty of their colours. Of these the MINIMUS, FLY-BIRD, or LEAST HUMMING BIRD, the most diminutive of the feathered tribe, may be cited as among the most interesting of the minute wonders of nature. It is exceeded, both in weight and dimensions, by several species of bees. Its total length is one inch and a quarter; and, when killed, it does not weigh more than about twenty grains. The bill is straight and black, three lines and a half in length: the upper parts of the body are of a greenish brown, in some lights appearing reddish: the under parts are greyish white; the wings are violet brown; the tail of a bluish black, with a gloss of polished metal; but the outer feathers, except one on each side, are grey from the middle to the tip, and the outer one wholly grey: the legs and claws are brown. The female is still less than the male.

These birds, which are natives of the Brazils, of various parts of South America, and of the adjacent islands, subsist on the nectar or sweet juice of flowers, frequenting those most which have a long tube. They never settle on the flower during the act of extracting the juice, but flutter continually like bees, moving their wings very briskly, and making a humming noise, whence they have received their names. They are not shy; but when very nearly approached fly off like an arrow from a bow. They often meet and fight for the right to a flower, and this all on the wing: in this state they often enter an apartment, the windows of which are open, fight a little, and go out again. When they come to a flower which is juiceless, or on the point of withering, they pluck it off as it were in anger, by which means the ground is often strewed with flowers. In flying against each other, they have, besides the humming, a chirping note resembling that of the sparrow.—They do not feed either on insects or fruits; but have been kept alive in cages for several weeks, by feeding them with sugared water.

The humming bird builds most frequently in the middle



No. 54.—Termites Ant Hills.



No. 55.—Termites Pyramids.

of a branch of a tree, the nest being so small that it cannot be seen by one standing on the ground beneath. It is round; is composed externally of fine green moss; and has its inside lined with soft down, collected either from the leaves of the great mullien, or from silk grass The eggs, of which the female lays two, are white, and of the size of a pea.

During his stay at the Brazils, Mr. Forbes visited almost daily a lovely valley in the neighbourhood of St. Sebastian. "There," he observes, "thousands of nature's choristers, arrayed in all the brilliancy of tropical plumage, enlivened the extensive orange groves; and the humming-bird, the smallest and most lovely of the feathered race, buzzed like the bee, while sipping the nectareous dew from the blossoms of the flowers. Nothing can exceed the delicacy of these little beauties; especially of that which, from its minuteness, is called the fly-bird; its bill and legs are not thicker than a pin; its head, tufted with glossy jet, varies with every motion into shades of green and purple; the breast is of a bright flame colour; every feather, when viewed through a microscope, appears as if fringed with silver, and spotted with gold."

EDIBLE BIRDS' NESTS.

Among the interesting subjects which still remain open for research, are the habits and constitution of the HIRUNDO ESCULENTA, the small swallow which forms the edible nests, annually exported in large quantities from Java and the eastern islands for the Chinese market. These birds Governor Raffles observes, in his history of Java, not only abound among the cliffs and caverns of the south coast of that island, but inhabit the fissures and caverns of several of the mountains and hills in the interior of the country. From every observation which has been made in Java, it has been inferred that the mucilaginous substance of which the nests are formed, is not, as has been generally supposed, obtained from the ocean. The birds, it is true, generally inhabit the caverns in the vicinity of the sea, as agreeing best with their habits, and affording them the most convenient retreats to which to attach their nests; but several caverns are found inland, at a distance of forty or fifty miles

from the sea, containing nests similar to those on the shore. From many of their retreats along the southern coast, they have been observed to take their flight in an inland direction, towards the pools, lakes, and extensive marshes, covered with stagnant water, as affording them abundance of their food, which consists of flies, musquitoes, gnats, and small insects of every description. The sea, which washes the foot of the cliffs, where they most abound, is almost always in a state of the most violent agitation, and affords none of those substances which have been supposed to constitute the food of the esculent swallow. Another species of swallow in the island of Java, forms a nest, in which grass, moss, &c. are merely agglutinated by a substance exactly similar to that of which exclusively the edible nests consist. This substance, from whatever part of those regions the nests be derived, is essentially uniform, differing only in the colour, according to the relative age of the nests. It exhibits none of those diversities which might be expected, if, like the mud employed by the martin, and the materials commonly used in nest-making, it were collected casually, and applied to the rocks. Were it to consist of the substances usually supposed, it would be putrescent and diversified.

THE MIGRATION OF BIRDS.

Yea, the stork in the heavens knoweth her appointed times; and the turtle, and the crane, and the swallow, observe the time of their coming.

JEREMIAH.

Who bids the stork, Columbus like, explore
Heavens not his own, and worlds unknown before?
Who calls the council, states the certain day?
Who forms the phalanx, and who points the way?

POPE.

THE migration of birds, which is common to the quail, the stork, the crane, the fieldfare, the woodcock, the cuckoo, the martin, the swallow, and various others, is justly considered as one of the most wonderful instincts of nature. Two circumstances, Doctor Derham observes, are remarkable in this migration: the first, that these uninstructed creatures should know the proper times for their passage, when to come, and when to go, some departing while others

arrive; and, secondly, that they should know which way to steer their course, and whither to go.

Birds of passage are all peculiarly accommodated, by the structure of their parts, for long flights; and it is remarked that, in their migrations they observe a wonderful order and polity: they fly in troops, and steer their course, without the aid of compass, to vast unknown regions. The flight of wild geese, in a wedge-like figure, has often been observed; and it has been noticed that the three foremost, who are the soonest tired, retreat behind, and are relieved by others, who are again succeeded by the rest in order. At the approach of winter the wild ducks and cranes of the north fly in quest of more favourable climates. They all assemble, at a certain day, like swallows and quails, decamping at the same time. Their flight is highly curious: they generally range themselves in a long column like an I: or in two lines united in a point, like a V reversed. It is observed by Shaw, in his travels, that storks, about a fortnight before they pass from one country to another, constantly resort together from all the circumjacent parts, to a certain plain, and there forming themselves daily into what, in the popular phrase is, called a *dou wanne*, determine the exact time of their departure, and the places of their future abode.

Swallows have often been observed, in innumerable flocks, on churches, rocks, and trees, previously to their departure from Great Britain; and their return, in apparently equal numbers, has been witnessed in a variety of instances. In Sweden, the starling, finding, after the middle of summer, that worms are less plentiful, goes annually into Scania, Germany, and Denmark. The female chaffinches, every winter about Michaelmas, go in flocks to Holland; but as the males stay in Sweden, the females come back in the spring, except such as do not chose to breed any longer. In the same manner, the female Carolina yellow-hammer, in the month of September, while the rice on which she feeds is laid up in granaries, goes towards the south, and returns in the spring to seek her mate. The aquatic birds of the north are forced by necessity to fly toward the south every autumn before the water is frozen. Thus the lakes of Poland and Lithuania are filled with swans and geese in the autumnal season, at which time they go in great flocks, along many rivers, as far as the Euxine sea. In the

beginning of spring, however, as soon as the heat of the sun molests them, they return back, and again frequent the borders of the springs and lakes, where the females deposit their eggs; for there, and especially in Lapland, a vast abundance of gnats—insects which live in the water before they get their wings—afford them an excellent nourishment. By these migrations, birds become useful to many countries, and are distributed over almost every part of the globe.

THE TERMITES, OR WHITE ANTS.

[*See Plates, No.* 54, 55.]

Of these very surprising insects naturalists describe four species, the largest of which is the TERMES BELLICOSUS, or BELLIGERENT TERMITE. The nests of these insects are large handsome pyramids, ten or twelve feet and upwards above the surface of the earth, and as many beneath it. The second species is named the FATAL TERMITE, the nests of which are likewise of a pyramidal form, but neither so lofty nor extensive as the former. Its ravages, however, are more fatal, and its punctures more painful and dangerous. The BITING TERMITE forms the third species, and constructs its nest in the form of a cylindrical turret, four feet high, and one in diameter. The turret is covered with a conical roof, which projects some inches over, and beyond the building, doubtless to prevent it from being injured by the rain. The DESTROYING TERMITE constitutes the fourth species, and constructs spherical nests round the branch of a tree, which passes entirely through them.

The TERMES BELLICOSUS, according to Mr. Smeathman, whose account has appeared in the Philosophical Transactions, constructs works which surpass those of the bees, wasps, beavers, and other animals, as much at least as those of the most polished European nations excel those of the least cultivated savages. Even with regard to man, his greatest works, the boasted pyramids, fall comparatively far short, even in size alone, of the structures raised by these insects. The labourers among them employed in this service are not a quarter of an inch in length; but the structures which they erect, rise, as has already been observed, to the height of ten or twelve feet and upwards above the surface of the earth. Supposing the height of a man to be six feet, this author calculates, that the buildings

of these insects may be considered, relatively to their size, and that of a man, as being raised to nearly five times the height of the greatest of the Egyptian pyramids; that is, corresponding with considerably more than half a mile. It may be added, that, with respect to the interior construction, and the various members and dispositions of the parts of the buildings, they appear greatly to exceed that, or any other work of human construction.

The most striking parts of these structures are, the royal apartments, the nurseries, magazines of provisions, arched chambers and galleries, with their various communications; the ranges of the gothic-shaped arches, projected, and not formed by mere excavation, some of which are two or three feet high, but which diminish rapidly, like the arches of aisles in perspectives; the various roads, sloping staircases, and bridges, consisting of one vast arch, and constructed to shorten the distance between the several parts of the building, which would otherwise communicate only by winding passages. In the plate, a section is given of one of these surprising mounds or ant hills; and likewise the section of a pyramid surmounted by its conical roof. In some parts near Senegal, the number, magnitude, and closeness of these structures, make them appear like the villages of the natives.

The economy of these industrious insects is equally curious with the plan and arrangement of the interior of their buildings. There are three distinct ranks or orders among them, constituting a well regulated community. These are, first, the *labourers*, or working insects; next, the *soldiers*, or fighting order, who abstain from all labour, and are about twice as long as the former, and equal in bulk to about fifteen of them; and, lastly, the winged, or perfect insects, which may be styled the *nobility* or *gentry*, of the state; for they neither labour nor fight, being scarcely capable even of self-defence. These alone are capable of being elected *kings* or *queens*; and it has been so ordained by nature, that they emigrate within a few weeks after they are elevated to this state, and either establish new kingdoms or perish in the space of one or two days.

The first order, the working insects, are most numerous, being in the proportion of one hundred to one of the soldiers. In this state they are about a quarter of an inch

long, and twenty-five of them weigh about a grain, so that they are not so large as some of the ants of Europe.

The second order, or soldiers, have a very different form from the labourers, and have been by some authors supposed to be the males, and the former the neuters; but they are, in reality, the same insects as the foregoing, only that they have undergone a change of form, and approached one degree nearer to the perfect state.

The third order, or the insect in its perfect state, varies its form still more than ever, differing in every essential part from the labourers and soldiers; besides which, it is now furnished with four fine, large, brownish, transparent wings, with which it is, at the time of emigration, to wing its way in search of a new settlement. The difference is, indeed, so great, that these perfect insects have not, until recently, been supposed to belong to the same community with the others, and are not to be discovered in the nest until just before the commencement of the rainy season, when they undergo the last change, which is preparative to the formation of new colonies. They are equal in bulk to two soldiers and about thirty labourers; and, with the aid of their wings, roam about for a few hours, when their wings fall off, and they become the prey of innumerable birds, reptiles, and insects. Hence it happens that scarcely a pair of the many millions of this unhappy race, find a place of safety, to fulfil the first law of nature, and lay the foundation of a new community. In this state many fall into the neighbouring waters, and are eaten with avidity by the Africans, who roast them in the manner of coffee, and find them delicate, nourishing, and wholesome.

The few fortunate pairs who survive this annual massacre and destruction, being casually found by some of the labourers, who are constantly running about on the surface of the ground, are elected kings and queens of new states. Those who are not so elected and preserved, certainly perish, and most probably in the course of the following day. By these industrious creatures the king and queen elect are immediately protected from their innumerable enemies, by inclosing them in a chamber of clay, where the propagation of the species soon commences. Their voluntary subjects then busy themselves in constructing wooden nurseries, or apartments solely composed of wood-

en materials, seemingly joined together with gums. Into these they afterwards carry the eggs produced by the queen, lodging them as fast as they can obtain them from her. Plausible reasons are given by Mr. Smeathman for the belief he entertains, that they here form a kind of garden for the cultivation of a species of microscopical mushroom; and in this belief he is supported by Mr. Konig, in his essay on the East-Indian termites, by whom also this is conjectured to be the food of the young insects. But perhaps the most wonderful, at the same time best authenticated, part of the history of these curious insects, is that which relates to the queen, or mother of the community in her pregnancy.

After impregnation, a very extraordinary change begins to take place in her person, or rather in her abdomen only. It gradually increases in bulk, and at length becomes of such an enormous size as to exceed the bulk of the rest of her body 1500 or 2000 times. She becomes 1000 times heavier than her consort, and exceeds 20,000 or 30,000 times the bulk of one of the labourers. In this state 80,000 eggs (for they have been counted) are protruded in twenty-four hours. They are instantly taken from her body by the attendants, a sufficient number of whom are constantly in waiting in the royal chambers, and adjacent galleries, and carried to the nurseries, which are sometimes four or five feet distant in a straight line. Here, after they are hatched, the young are attended and provided with every thing necessary, until they are able to shift for themselves, and take their share in the labours of the community.

Many curious and striking particulars are related of the great devastations committed by this powerful community, which construct roads, or rather covered ways, diverging in all directions from the nest, and leading to every object of plunder within their reach. Though the mischiefs they commit are very great, such is the economy of nature, that they are probably counterbalanced by the good produced by them, in quickly destroying dead trees and other substances, which would otherwise, by a tedious decay, serve only to encumber the face of the earth. Such is their alacrity and dispatch in this office, that the total destruction of deserted towns is accomplished in two or three years, and their space filled by a thick wood, not the least vestige of a house remaining.

At Bombay, Mr. Forbes observes in his memoirs, they are so numerous and destructive that it is difficult to guard against their depredations: in a few hours they will demolish a large chest of books, papers, silk, or clothes, perforating them with a thousand holes: the inhabitants dare not leave a box on the floor without placing it on glass bottles, which, if kept free from dust, they cannot ascend: this is trifling, when compared with the serious mischief they sometimes occasion, penetrating the beams of a house, or destroying the timbers in a ship.

These destructive animals advance by myriads to their work, under an arched incrustation of fine sand, tempered with a moisture from their body, which renders the covert-way as hard as burnt clay, and effectually conceals them in their insidious employment.

Mr. Forbes, on his departure from his residence at Anjengo, to pass a few weeks at a country retirement, locked up a room containing books, drawings, and a few valuables; as he took the key with him, the servant could not enter to clean the furniture: the walls of the room were white-washed, and adorned with prints and drawings, in English frames and glasses: returning home in the evening, and taking a cursory view of his cottage by candle light, he found every thing apparently in the same order as he left it; but on a nearer inspection the next morning, he observed a number of advanced works, in various directions, towards his pictures; the glasses appeared to be uncommonly dull, and the frames covered with dust: on attempting to wipe it off, he was astonished to find the glasses fixed to the wall, not suspended in frames as he left them, but completely surrounded by an incrustation cemented by the white ants, who had actually eaten up the deal frames and back-boards, and the greater part of the paper, and left the glasses upheld by the incrustation, or covered-way, which they had formed during their depredation. From the flat Dutch bottles, on which the drawers and boxes were placed, not having been wiped during his absence, the ants had ascended the bottles by means of the dust, eaten through the bottom of a chest, and made some progress in perforating the books and linen.

The different functions of the labourers and soldiers, or the civil and military establishments, in a community of white ants, are illustrated by Mr. Smeathman in an attempt to

examine their nest or city. On making a breach in any part of this structure with a hoe or pick-axe, a soldier immediately appears, and walks about the breach, as if to see whether the enemy is gone, or to examine whence the attack proceeds. In a short time he is followed by two or three others, and soon afterwards by a numerous body, who rush out as fast as the breach will permit them, their numbers increasing as long as any one continues to batter the building. During this time they are in the most violent bustle and agitation; some being employed in beating with their forceps upon the building, so as to make a noise which may be heard at three or four feet distance. On ceasing to disturb them the soldiers retire, and are succeeded by the labourers, who hasten in various directions towards the breach, each with a burden of mortar in his mouth ready tempered. Though there are millions of them, they never stop or embarass each other; and a wall gradually arises to fill up the chasm. A soldier attends every 600 or 1000 of the labourers, seemingly as a director of the works; for he never touches the mortar, either to lift or to carry it. One in particular places himself close to the wall under repair, and frequently makes the above-mentioned noise, which is constantly answered by a loud hiss from all the labourers within the dome: and at every such signal, they evidently redouble their pace, and work as fast again.

The work being completed, a renewal of the attack constantly produces the same effects. The soldiers again rush out, and then retreat, and are followed by the labourers loaded with mortar, and as active and as diligent as before. Thus the pleasure of seeing them come out to fight or work alternately, Mr. Smeathman observes, may be obtained as often as curiosity excites, or time permits; and it will certainly be found that the one order never attempts to fight, nor the other to work, let the emergency be ever so great. The obstinacy of the soldiers is remarkable: they fight to the very last, disputing every inch of ground so well as often to drive away the negroes, who are without shoes, and make white people bleed plentifully through their stockings.

Such is the strength of the buildings erected by these puny insects, that when they have been raised to little more than half their height, it is the constant practice of the African

wild bulls to stand as centinels upon them, while the rest of the herd are ruminating below. When at their full height of ten or twelve feet, they are used by Europeans as look-out stations whence they can see over the grass, which in Africa is on an average of the height of thirteen feet. Four or five persons may stand on the top of one of these buildings to look out for a vessel the approach of which is expected.

THE BEE.

To their delicious task the fervent bees,
In swarming millions tend: around, athwart,
Through the soft air, the busy nations fly,
Cling to the bud, and with inserted tube,
Suck its pure essence, its ethereal soul;
And oft, with bolder wing, they soaring dare
The purple heath, or where the wild thyme grows,
And yellow load them with the luscious spoil.

THOMSON.

THE wisdom of the bees, the perfection and harmony of their government, their persevering industry, and their wonderful economy, have been celebrated by the natural historians of every age. Indeed, the skill and dexterity displayed by the honey bees, in the construction of their combs or nests are truly wonderful. These are composed of cells regularly applied to each other's sides, and uniformly of an hexagonal or six-sided figure. In a bee-hive, every part is arranged with such symmetry, and so finely finished, that, if limited to the same materials, the most expert workman would find himself unqualified to construct a similar habitation, or rather a similar city.

In the formation of their combs, bees seem to have resolved a problem which would perplex geometers not a little; namely, a quantity of wax being given, to make of it equal and similar cells of a determined capacity, but of the largest size in proportion to the quantity of matter employed, and disposed in such a manner as to occupy in the hive the least possible space. Every part of this problem is completely executed by the bees. By applying hexagonal cells to each other's sides, not any void spaces are left between them; and, although the same end might be accomplished by other figures, yet they would necessarily require a greater quantity of wax. Hexagonal cells are, besides, better fitted

to receive the cylindrical bodies of these insects. A comb being made to consist of two rows of cells applied to each other's ends, this arrangement both saves room in the hive, and gives a double entry into the cells of which the comb is composed. As a further saving of wax, and for the prevention of void spaces, the bases of the cells in one row of a comb serve for bases to the opposite row. In a word, the more minutely the construction of these cells is examined, the more is the admiration of the observer excited. Their walls are so extremely thin, that the mouths of the bees would, in entering and passing out continually, be in danger of suffering; to prevent which, a kind of ring, three or four times thicker than the walls, is formed round the margin of each cell.

The mode in which bees operate, when constructing their cells, is not easily to be traced, even with the help of glass hives. They are so eager to afford mutual assistance, and for this purpose so many of them crowd together, and are perpetually succeeding each other, that their individual operations can seldom be distinctly observed. It has, however, been fully ascertained that, in modelling and polishing the wax, they do not employ any other instruments besides their two teeth. With a little patience and attention, cells may be perceived just begun; and the celerity with which a bee moves its teeth against a small proportion of one of these cells, may also be remarked. The little animal, by repeated strokes on each side smooths this portion, renders it compact, and reduces it to a proper thinness of consistence. While some of the hive are lengthening their hexagonal tubes, others are laying the foundations of new ones. When a bee puts its head a little way into a cell, it may easily be perceived to scrape the walls with the points of its teeth, in order to detach such useless and irregular fragments as may have been left in the work. Of these fragments it forms a ball about the size of a pin's head, comes out of the cell, and carries the wax to another part of the work where it is needed It no sooner leaves the cell, than it is succeeded by another bee, which performs the same office; and in this manner the work is carried on till the cell is completely polished.

The cells are designed for different purposes, some being employed for the accumulation and preservation of honey,

while in others the female deposits her eggs, from which worms are hatched, to remain in the cells until their final transformation into winged insects. The drones or males are larger than the common working bees; and the queen, or mother of the hive, is much larger than either. A cell destined for the lodging of a male or female worm must therefore be considerably larger than the cell of the smaller working bees. Those destined for the reception of the working bees are far more numerous than those in which the males are lodged. The honey-cells are always made deeper and more capacious than the others. When the honey collected is so abundant that the receptacles cannot contain it, the bees lengthen, and consequently deepen the honey-cells.

Bees, when placed in an empty hive, display the highest sagacity, as well in their mode of working, as in the disposition and division of their labour. They immediately begin to lay the foundations of their combs, a task which they execute with great quickness and alacrity. Shortly after having begun to construct one comb, they divide themselves into two or three companies, each of which, in a different part of the hive, is occupied with the same labours. By this division of the task, a greater number of bees find employment at the same time, and, consequently, the common work is sooner finished. The combs are generally arranged in a direction parallel to each other, an interval, or street, being always left between them, that the bees may have a free passage, and an easy communication with the different combs in the hive. These streets are wide enough to allow two bees to pass each other; and there are, besides, several round cross passages, always covered, to shorten their journies when working.

By the means of their hinder thighs, bees carry into their hives great quantities of the farina or dust of flowers, which, after having been thus industriously collected, becomes their food, and is, by an animal process, converted into wax. This digestive process, which is necessary to the formation of that substance, is carried on in the second stomach, and perhaps in the intestines of bees. Reamur, to whom the merit of this discovery is due, likewise ascertained that all the cells in a hive are not destined for the reception of honey, and for depositing the eggs of the fe-

male, but that some of them are employed as receptacles for the farina of flowers, which is the great basis and raw material of all their curious operations. When a bee comes to the hive with its thighs filled with farina, it is often met near the entrance by some of its companions, who first take off the load, and then devour the provisions so kindly brought to them. But when the members of the community are no longer oppressed by hunger, the carriers of the farina deposit their loads in cells prepared for that purpose. To these cells the bees resort, when the weather is so bad that they cannot venture into the fields to seek a fresh supply of food. The farina being digested, and converted into wax, the bees possess the faculty of bringing it from the stomach to the mouth, employing the tongue, which is placed beneath the two teeth, or fangs, in supplying the materials for the construction of their waxen cells. When at work, this member is in perpetual and rapid motion; being at times more or less concave, and partly covered with a moist paste or wax. By its different movements the bee continues to supply fresh wax to the teeth, which are employed in raising and fashioning the walls of its cell, till they have acquired a sufficient height. The moist paste or wax is no sooner dry, than it assumes all the appearances of common wax.

Bees not only require much warmth, but are also extremely solicitous to prevent other insects from an entrance into their hives. To accomplish both these purposes, when they take possession of a new hive, they carefully examine every part of it, and, if they discover any small holes or chinks, paste them firmly with a resinous substance collected from various trees, as poplars, birches, and willows, differing entirely from wax, more durable, and more capable of resisting the vicissitudes of weather. A bee having procured a sufficient quantity of this purely natural production, to fill the cavities of its two hinder thighs, repairs to the hive, where two of its companions are in readiness to draw out the glue, and apply it to fill up such chinks, holes, or other deficiencies, as they find in their habitation. This is not, however, the only use to which bees apply the glue. They are extremely solicitous to remove such insects, or foreign bodies, as chance to introduce themselves into the hive. When so light as not to exceed their pow-

ers, they first kill the insect with their stings, and then drag it out with their teeth. But it sometimes happens that a snail creeps into the hive; in which case it is no sooner perceived, than it is attacked on all sides, and stung to death. The bees being unable to carry out a burden of such a weight, to prevent so large a body from diffusing a disagreeable odour through the hive, instantly cover every part of it with glue, through which not any effluvia can escape. When a snail with a shell finds an entrance, the bees have less trouble, since it naturally retires within its shell, on receiving the first wound from a sting. In this case, the bees, instead of glueing it all over, satisfy themselves with passing the glue round the margin of the shell, which renders the animal immovably fixed.

Bees being prevented by the weather, not only during the winter, but on many summer days, from going abroad in quest of provisions, collect and amass, in cells destined for that purpose, large quantities of honey, which they extract, by means of their proboscis or trunk, from the nectariferous glands of flowers. After collecting a few small drops, the animal, with its proboscis, conveys them to its mouth, and swallows them. From the gullet, the honey passes into the first stomach, which is more or less swollen in proportion to the quantity of honey it contains. When filled, the bee returns to the hive, and disgorges in a cell the honey it has collected. It occasionally happens, however, that it is accosted on its way by a hungry companion. How the latter communicates its necessity to the other, remains to be discovered; but the fact is certain, that when two bees, thus circumstanced, meet, the one which is laden extends its trunk, opens its mouth, and, like ruminating animals, forces up the honey into that cavity. The hungry bee knows how to take advantage of this hospitable invitation, and, with the point of its trunk, sucks the honey from the other's mouth. In the same way, the loaded bee, on reaching the hive, offers its honey to those who are at work, as if to save them the necessity of quitting their labour to proceed in quest of food. In bad weather, the bees feed on the honey laid up in open cells; but never touch these reservoirs when their companions are enabled to supply them with fresh honey from the fields. But the mouths of those cells which are destined to preserve the

honey for winter's use, are carefully covered with a lid or thin plate of wax.

The honey bees not only labour in common with astonishing assiduity and art, but their whole attention and affections seem to centre in the person of THE QUEEN or SOVEREIGN of the hive. She is the basis of their association, and of all their operations. When she dies by any accident, disorder ensues throughout the community: all labour ceases; there is an end to the construction of new cells, as well as to the collection of either honey or wax. In this state of anarchy the bees remain, until a new queen or female is obtained, to effect which they have the power of selecting one or two grubs of workers, and converting them into queens. This they accomplish by greatly enlarging the cells of the selected *larvas*, by supplying them more copiously with food, and that of a more pungent kind than is given to the common larvas.

The government or society of bees is therefore more of a monarchial than of a republican nature. All the members of the state seem to respect and be directed by a single female. This fact affords a strong instance of the force and wisdom of nature. The female is the mother of the whole hive, however numerous; and without her the species could not be continued. Nature has therefore endowed the rest of the hive with a wonderful affection to their common parent. For the reception of her eggs nature impels them to construct cells, and to lay up stores of provisions for winter subsistence. These operations proceed from pure instinctive impulses it is true, but every instinct necessarily supposes a degree of intellect, a principle to be acted upon, otherwise not any impulsion could be felt, nor could either action or mark of intelligence possibly be produced.

On the subject of SWARMS, the following are the conclusions drawn by M. Huber, who has paid particular attention to the economy and habits of bees. First: a swarm is always led off by a single queen, either the sovereign of a parent hive, or one recently brought into existence. If, at the return of spring, a well-peopled hive, under the government of a fertile queen, be examined, she will be seen to lay a prodigious number of male eggs in the course of the month of May, and the workers will choose that moment

for constructing several royal cells. Secondly: when the larvas hatched from the eggs, laid by the queen in the royal cells, are ready for a transformation into nymphs, this queen leaves the hive, conducting a swarm along with her; and the first swarm that leaves the hive is uniformly conducted by the old queen. Lastly: after the old queen has conducted the first swarm from the hive, the remaining bees take particular care of the royal cells, and prevent the young queens successively hatched, from leaving them, unless at an interval of several days between each.

TRANSFORMATION OF INSECTS.

Nature's smallest products please the eye,
While greater births pass unregarded by,
Her monsters seem a violence to sight:
They're form'd for terror, insects to delight.
Thus, when she nicely frames a piece of art,
Fine are her strokes, and small in every part.
No labour can she boast more wonderful
Than to inform an atom with a soul;
To animate her little beauteous fly,
And clothe it in her gaudiest drapery.

YALDEN.

ALL winged insects, without exception, and many of those which are destitute of wings, have to pass through several changes before they arrive at the perfection of their natures. The appearance, the structure, and the organs of a caterpillar, a crysalis, and a fly, are so different, that, to a person unacquainted with their transformations, an identical animal would be considered as three distinct species. Without the aid of experience, who could believe that a butterfly, adorned with four beautiful wings, furnished with a long spiral proboscis, instead of a mouth, and with six legs, proceeded from a disgusting caterpillar, provided with jaws and teeth, and fourteen feet? Without experience, who could imagine that a long, white, smooth, soft worm, hid under the earth, should be transformed into a black crustaceous beetle, having wings covered with horny cases?

Besides their final metamorphosis into flies, caterpillars undergo several intermediate changes. All caterpillars cast or change their skins more or less frequently according to the

species. The silkworm, previous to its chrysalis state casts its skin four times. The first skin is cast on the 10th, 11th, or 12th day, according to the nature of the season; the second in five or six days after; the third in five or six days more: and the fourth and last in six or seven days after the third. This changing of skin is not only common to all caterpillars, but to every insect whatever. Not one of them arrives at perfection without casting its skin at least once or twice. The skin, after it is cast, preserves so entirely the figure of the caterpillar in its head, teeth, legs, colour, hair, &c. that it is often mistaken for the animal itself. A day or two before this change happens, caterpillars take no food; they lose their former activity, attach themselves to a particular place, and bend their bodies in various directions, till, at last, they escape from the old skin, and leave it behind them. The intestinal canal of caterpillars is composed of two principal tubes, the one inserted in the other: the external tube is compact and fleshy; but the internal one is thin and transparent. Some days before caterpillars change into the chrysalis state, they void, along with their excrement, the inner tube which lined their stomach and intestines. When about to pass over into the chrysalis state, which is a state of imbecility, they select the most proper places and modes of concealing themselves from their enemies. Some, as the silkworm and many others, spin silken webs or cords round their bodies, which completely disguise the animal form. Others leave the plants upon which they formerly fed, and hide themselves in little cells which they make in the earth. The rat-tailed worm abandons the water upon the approach of its metamorphosis, retires under the earth, where it is changed into a chrysalis, and, after a certain time, bursts from it seemingly inanimate condition, and appears in the form of a winged insect. Thus the same animals pass the first and longest period of their existence in the water, another under the earth, and the third and last in the air. Some caterpillars, when about to change into a chrysalis state, cover their bodies with a mixture of earth and of silk, and conceal themselves in the loose soil. Others incrust themselves with a silky or glutinous matter, which they push out from their mouths, without spinning it into threads. Others retire into the holes of walls or decayed trees. Others suspend them-

selves to the twigs of trees, or to other elevated bodies, with their heads undermost. Some attach themselves to walls, with their heads higher than their bodies, but in various inclinations: and others choose a horizontal position. Some fix themselves by a gluten, and spin a rope round their middle to prevent them from falling. Those which feed upon trees attach themselves to the branches, instead of the leaves, which are less durable, and subject to a variety of accidents. The colours of the caterpillar give no idea of those of the future flies.

The metamorphosis of insects has been regarded as a sudden operation, because they often burst their shell or silky covering quickly, and immediately appear furnished with wings. But by more attentive observation, it has been discovered, that the transformation of caterpillars is a gradual process from the moment the animals are hatched till they arrive at a state of perfection. Why, it may be asked, do caterpillars so frequently cast their skins? The new skin, and other organs, were lodged under their old ones, as, in many tubes or cases, and the animal retires from these cases, because they have become too strait. The reality of these encasements has been demonstrated by a simple experiment. When about to molt or cast its skin, if the foremost legs of a caterpillar are cut off, the animal comes out of the old skin deprived of these legs. From this fact, Reaumur conjectured, that the chrysalis might be thus encased, and concealed under the last skin of the caterpillar. He discovered that the chrysalis, or rather the butterfly itself, was inclosed in the body of the caterpillar. The proboscis, the antennæ, the limbs, and the wings of the fly, are so nicely folded up, that they occupy a small space only under the first two rings of the caterpillar. In the first six limbs of the caterpillar, are encased the six limbs of the butterfly. Even the eggs of the butterfly have been discovered in the caterpillar long before its transformation.

From these facts it appears, that the transformation of insects is only the throwing off external and temporary coverings, and not an alteration of the original form. Caterpillars may be considered as analogous to the fetuses of men and of quadrupeds. They live and receive nourishment in envelopes till they acquire such a degree of perfection as enables them to support the situation to which they are ultimately destined by Nature.

ZOOPHITES, OR PLANT-ANIMALS.

These wonderful productions are so denominated on account of their existing in the shape of plants. They are very numerous, and the greater part of them have so great a resemblance to vegetables, that they have generally been considered as such, although the horny and stony appearance of several of the tribe declares them at first view, to be of a widely different nature from the generality of plants. In others, however, the softness of their substance, and the ramified mode of their growth, would lead any one not acquainted with their real nature, to suppose them vegetables. The hard, horny, or stony zoophites are in general known by the name of corals; and of these several distinctions are formed, either from the structure and appearance of the coral or hard part, or from the affinity which the softer, or animal part, bears to some other genus among soft-bodied animals, or *mollusca.* The zoophites may be therefore said to unite the animal and vegetable kingdoms, so as to fill up the intermediate space.

Belonging to the class of zoophitic-worms, the fresh-water polypes are infinitely curious. These animals may be found in small streams, and in stagnant waters, adhering to the stems of aquatic plants, or to the under surface of the leaves, and other objects. If a polype be cut in two parts, the superior part will produce a new tail, and the inferior part a new head and arms; and this, in warm weather, in the course of a very few days. If cut into three pieces, the middle portion will produce both the head and tail; and in short, polypes may be cut in all directions, and will still reproduce the deficient organs. The natural mode of propagation in this animal, is by shoots or offsets, in the manner of a plant: one or more branches or shoots proceed from the parent stem, dropping off when complete; and it often happens that these young branches produce others before they themselves drop off from the parent; so that a polype may be found with several of its descendants still adhering to its stem, thus constituting a real genealogical tree. The polype likewise, during the autumnal season, deposits eggs, which evolve themselves afterwards into distinct animals;

and thus possesses two modes of multiplication. It seems paradoxical that a polype should be able to swallow a worm three or four times as large as itself, which is frequently observed to happen; but it must be considered that the body of the animal is extremely extensile, and that it possesses, in an extraordinary degree, the power of stretching itself according to the size of the substance it has to swallow. It seizes its prey with great eagerness, but swallows it slowly, in the same manner as a snake swallows any small quadruped. The arms of a polype, when microscopically examined, are found to be furnished with a vast number of small organs, apparently acting like so many suckers, by the means of which the animal can hold a worm, even though but slightly in contact with one of its arms; but when on the point of swallowing its prey, it then makes use of all its arms at once, in order to absorb it the more readily.

Corals on being gathered perfectly fresh, and placed in sea water, appear to put forth small flowers from all the minute cavities, or hollow points, on the surface. These supposed flowers (for such an idea has been entertained) are real animals; and consequently corals are to be considered as aggregates of animals, either forming, or at least inhabiting, the calcareous substance of the coral in which they appear. The smaller corals, commonly known by the name of corallines, or sea mosses, are so many ramified sea-polypes, covered with a kind of strong, horny case, to defend them from the injuries to which they would be liable, in the boisterous element destined for their abode. The harder, or stony corals are equally of an animal nature; the entire coral continuing to grow as an animal, and to form, by secretion, the stronger or horny exterior, which may at once be considered as its bone, and the habitation in which it has constantly to dwell. A coral of this kind is, therefore, a large compound zoophite, springing up from the rock, in which it seems to have taken root, and shooting out into branches like a vegetable production.

Sponges afford another curious instance of zoophitic life. There are forty-nine species of this zoophite, each of which is characterised in the Linnean system as a fixed animal, flexile, torpid, of various forms, composed either of reticulate fibres, or masses of small spines interwoven togeth-

er, and clothed with a gelatinous flesh, full of small mouths on its surface, by which it absorbs and rejects water. The existence of the animal inhabitant within its cell has been satisfactorily ascertained by the observations and experiments of Ellis on the *spongia tormentosa*. He remarked its contraction when exposed to pain or injury, as well as the expiration and inspiration of water through its tubes. He thus established the position that sponge is an animal, and that the ends or openings of the branched tubes are the mouths by which it receives its nourishment, and discharges its excremintitious matter. This position chemistry has since abundantly supported, by proving the ammoniacal property of the cellular substance of sponge.

THE BANIAN TREE.

[*See Plate, No.* 26.]

PROCEEDING to the vegetable kingdom, the BANIAN, or BURR TREE, the *ficus indica* of Linneus, claims a particular attention. It is considered as one of the most curious and beautiful of nature's productions in the genial climate of India, where she sports with the greatest profusion and variety. Each tree is in itself a grove, and some of them are of an amazing size, as they are continually increasing, and, contrary to most other animal and vegetable productions, seem to be exempted from decay: for every branch from the main body throws out its own roots, at first in small tender fibres, several yards from the ground, which continually grow thicker; until by a gradual descent, they reach its surface; where, striking in, they increase to a large trunk, and become a parent tree, throwing out new branches from the top. These in time suspend their roots, and, receiving nourishment from the earth, swell into trunks, and shoot forth other branches; thus continuing in a state of progression so long as the first parent of them all supplies her sustenance.

A banian tree with many trunks, forms the most beautiful walks, vistas, and cool recesses, that can be imagined. The leaves are large, soft, and of a lively green; the fruit is a small fig, when ripe of a bright scarlet; affording sustenance to monkeys, squirrels, peacocks, and birds of various kinds, which dwell among the branches.

The Hindoos are peculiarly fond of this tree: they con-

sider its long duration, its out-stretching arms, and over-shadowing beneficence, as emblems of the Deity, and almost pay it divine honours. The Brahmins, who thus "find a fane in every sacred grove," spend much of their time in religious solitude under the shade of the banian-tree; they plant it near the dewals, or Hindoo temples, improperly called pagodas; and in those villages where there is not any structure for public worship, they place an image under one of these trees, and there perform a morning and evening sacrifice.

These are the trees under which a sect of naked philosophers, called Gymnosophists, assembled in Arrian's days; and this historian of ancient Greece, it is observed by Forbes, in his Oriental Memoirs, affords a true picture of the modern Hindoos. "In winter the Gymnosophists enjoy the benefit of the sun's rays in the open air; and in summer, when the heat becomes excessive, they pass their time in cool and moist places, under large trees; which according to the accounts of Nearchus, cover a circumference of five acres, and extend their branches so far, that ten thousand men may easily find shelter under them.

On the banks of the Narbudda, in the province of Guzzerat, is a banian tree, supposed by some persons to be the one described by Nearchus, and certainly not inferior to it. It is distinguished by the name of the Cubbeer Burr, which was given to it in honour of a famous saint. High floods have, at various times, swept away a considerable part of this extraordinary tree; but what still remains is nearly two thousand feet in circumference, measured round the principle stems; the over-hanging branches, not yet struck down, cover a much larger space; and under it grow a number of custard apple, and other fruit trees.—The large trunks of this single tree amount to *three hundred and fifty*, and the smaller ones *exceed three thousand:* each of these is constantly sending forth branches and hanging roots, to form other trunks, and become the parents of a future progeny.

The Cubbeer Burr is famed throughout Hindostan, not only on account of its great extent, but also of its surpassing beauty. The Indian armies generally encamp around it; and, at stated seasons, solemn jatarras, or Hindoo festivals, to which thousands of votaries repair from every

part of the Mogul empire, are there celebrated. It is said that 7000 people find ample room to repose under its shade. It has long been the custom of the British residents in India, on their hunting and shooting parties, to form extensive encampments, and spend weeks together, under this magnificent pavilion, which affords a shelter to all travellers, particularly to the religious tribes of the Hindoos. It is generally filled with a variety of birds, snakes, and monkies, the latter of whom both divert the spectator by their antic tricks, and interest him by the parental affection they display to their young offspring, in teaching them to select their food, to exert themselves in jumping from bough to bough, and in taking, as they acquire strength, still more extensive leaps from tree to tree. In these efforts, they encourage them by caresses, when timorous, and menace, and even beat them, when refractory.

THE WEDDED BANIAN TREE.

AMONG the varieties of the Banian, or Burr trees, is the PEIPAL, or *ficus religiosa*, which is not uncommon in Guzzerat, and causes a singular variety of vegetation. It may be considered as belonging to the order of creepers, and often springs round different trees, particularly the palmyra, or palm. The latter growing through the centre of a banian tree, looks extremely grand. The peipal frequently shoots from old walls, and runs along them, so as to cause a singular phenomenon of vegetation. In the province of Bahar, one of these trees was seen by an English traveller, on the inside of a large brick well, the whole circumference of the internal space of which it lined, and thus actually became a tree turned inside out. A banian tree thus inverted is uncommon; but the general usefulness and beauty of this variety, especially in overshadowing the public wells and village markets, can only be known by those who live in a sultry climate.

THE COCOA-NUT TREE.

OF all the gifts which Providence has bestowed on the oriental world, the cocoa-nut tree is the one most deserving of notice. The blessings which are conveyed to man, by this single production of nature, are incalculable. It

grows in a stately column, from thirty to fifty feet in height, crowned by a verdant capital of waving branches, covered with long spiral leaves: under this foliage, bunches of blossoms, clusters of green fruit, and others arrived at maturity, appear in mingled beauty. The trunk, though porous, furnishes beams and rafters for the habitations; and the leaves, when platted together, make an excellent thatch, as well as common umbrellas, coarse mats for the floor, and brooms; while their finest fibres are woven into very beautiful mats for the rich. The covering of the young fruit is extremely curious, resembling a piece of thick cloth, in a conical form, as close and firm as if it came from the loom; it expands after the fruit has burst through its inclosure, and then appears of a coarser texture. The nuts contain a delicious milk, and a kernal sweet as the almond: this, when dried, affords abundance of oil; and when that is expressed, the remains feed cattle and poultry, and make a good manure. The shell of the nut furnishes cups, ladles, and other domestic utensils, while the husk which encloses it is of the utmost importance: it is manufactured into ropes, and cordage of every kind, from the smallest twine to the largest cables, which are far more durable than those of hemp. In the Nicobar islands, the natives build their vessels, make the sails and cordage, supply them with provisions and necessaries, and provide a cargo of arrack, vinegar, oil, jaggree or coarse sugar, cocoa-nuts, coir, cordage, black paint, and several inferior articles, for foreign markets, entirely from this tree.

Many of the trees are not permitted to bear fruit; but the embryo bud, from which the blossoms and nuts would spring, is tied up to prevent its expansion; and a small incision being then made at the end, a cool pleasant liquor, called Tarce, or Toddy, the palm-wine of the poets, oozes out in gentle drops.

THE UPAS, OR POISON TREE.

Although a serious refutation of the gross imposition practised on the people of Europe, by the romance of Foersch on the subject of the Upas, or celebrated poison-tree of Java, may at this time be in a great measure superfluous, as the world has long ceased to be the dupe of his story, and as regular series of experiments have been instituted,

both in England and in France, to ascertain the nature and potency of the poison; yet an authentic account of this poison, as drawn out by Dr. Horsfield, and published in the seventh volume of the Batavian transactions, cannot fail to be interesting. Almost every one has heard of its fabulous history, which, from its extravagant nature, its susceptibility of poetical ornament, its alliance with the cruelties of a despotic government, and the sparkling genius of Darwin, whose purpose it answered to adopt and personify it as a malignant spirit (in his Loves of the Plants), has obtained almost equal currency with the wonders of the Lernian hydra, or any other of the classic fictions of antiquity.

Although, the Doctor observes, the account published by Foersch, so far as relates to the situation of the poison-tree, to its effects on the surrounding country, and to the application said to have been made of the upas on criminals in different parts of the island, has, as well as the description of the poisonous substance itself, and its mode of collection, been demonstrated to be an extravagant forgery; the existence of a tree on Java, from the sap of which a poison is prepared, equal in fatality, when thrown into the circulation, to the strongest animal poisons hitherto known, is a fact which it is his object to establish and illustrate. The tree which produces this poison is the anchar, and grows in the eastern extremity of the island. The work of Rhumphius contains a long account of the upas, under the denomination of arbor toxicaria. The tree does not grow on Ambonia, and his description was made from the information he obtained from Makasar. His figure was drawn from a branch of what is called the male-tree, sent to him from the same place, and establishes the identity of the poison tree of Makasar, and the other eastern Islands, with the anchar of Java. The simple sap of the arbor toxicaria, (according to Rhumphius) is harmless, and requires the addition of several substances of the affinity of ginger, to render it active and mortal. In so far it agrees with the anchar, which, in its simple state, is supposed to be inert, and, before being employed as a poison, is subjected to a particular preparation. Besides the true poison-tree, the upas of the Eastern Islands, and the anchar of the Javans, this island produces a shrub, which, as far as observations have hitherto been made, is peculiar to the same, and by

a different mode of preparation, furnishes a poison far exceeding the upas in violence. Its name is chetik; but the genus to which it belongs has not yet been discovered or described.

The anchar is one of the largest trees in the forests of Java. The stem is cylindrical, perpendicular, and rises completely naked to the height of sixty, seventy, or eighty feet. It is covered with a whitish bark, slightly bursting in longitudinal furrows. Near the ground this bark is, in old trees, more than half an inch thick, and, upon being wounded, yields plentifully the milky juice from which the celebrated poison is prepared. A puncture or incision being made into the tree, the juice or sap appears oozing out, of a yellowish colour (somewhat frothy) from old, paler, or nearly white, from young ones; exposed to the air, its surface becomes brown. The consistence very much resembles milk; but it is more thick and viscid. This sap is contained in the true bark (or cortex), which, when punctured, yields a considerable quantity, so that in a short time a cup-full may be collected from a large tree. The inner bark (or liber) is of a close fibrous texture, like that of the morus papyrifera, and, when separated from the other bark, and cleansed from the adhering particles, resembles a coarse piece of linen. It has been worked into ropes, which are very strong; and the poorer class of people employ the inner bark of the younger trees, which is more easily prepared, for the purpose of making a coarse stuff which they wear in working in the fields. But it requires much bruising, washing, and a long immersion, before it can be used; and, when it appears completely purified, persons wearing this dress, being exposed to rain, are affected with an intolerable itching, which renders their flimsy covering insupportable. It appears from the account of the manner in which the poison is prepared, that the deleterious quality exists in the gum, a small portion of which still adhering, produces, when exposed to wet, this irritating effect; and it is singular that this property of the prepared bark is known to the Javans in all places where the tree grows, while the preparation of a poison from its juice, which produces a mortal effect when introduced into the body by pointed weapons, is an exclusive art of the inhabitants of the eastern extremity of the island.

WONDERS OF ART.

PYRAMIDS OF EGYPT.

[*See Plates, No.* 56, 57, 58.]

The largest of these stupendous monuments, equally famous for the enormity of their size, and their remote antiquity, are those of Djiza, so called from a village of that name on the bank of the Nile, distant from them about eleven miles. The three which most attract the attention of travellers stand near one another on the west side of the river, almost opposite to Grand Cairo, and not far from the site of the ancient Memphis. When viewed from a distance peering above the horizon, they display the fine transparent hue they derive from the rarified air by which they are surrounded. M. Savary having approached to within three leagues of them, in the night time, while the full moon shone bright upon them, describes them as appearing to him, under this particular aspect, like two points of rock crowned by the clouds. On a nearer approach, their sloping and angular forms disguise their real height, and lessen it to the eye; independently of which, as whatever is regular is great or small by comparison, and as these masses of stone eclipse in magnitude every surrounding object, at the same time that they are inferior to a mountain, to which alone the imagination can successfully compare them, a degree of surprise is excited on finding the first impression produced by a distant view so much diminished in drawing near to them. On attempting, however, to measure any one of these gigantic works of art by some known and determinate scale, it resumes its immensity to the mind; since, on drawing near to the opening, the persons who stand beneath it appear so small that they can scarcely be taken for men.

The base of the great pyramid of Cheops, or Cheospes, so named after a king of Egypt, is estimated by Denon at seven hundred and twenty feet, and its height at four hundred and forty-eight feet, calculating the base by the mean proportion of the length of the stones, and the height by the sum of that of each of the steps o[illegible]ges. Its con-

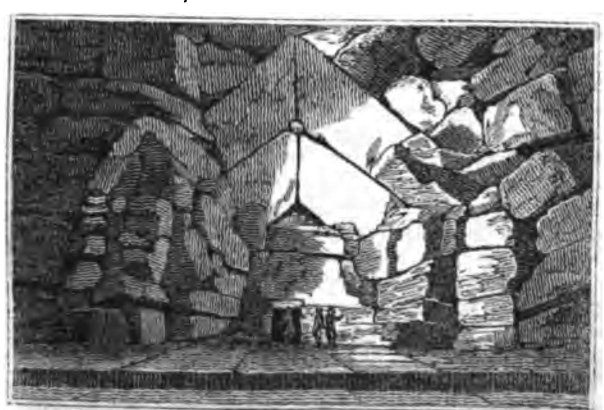
struction required so many years, and employed such a multitude of labourers, that the expenditure for garlic and onions alone, for their consumption, is said to have amounted to one thousand and sixty talents, upwards of one fourth of a million sterling. Its interior is thus accurately described by the above traveller.

"The entrance of the first gallery is concealed by the general outer covering which invests the whole of the pyramid. It is, however, probable, that the attention of the earlier searchers was by some particular appearance directed to this spot. This gallery goes towards the centre of the edifice, in a direction sloping downward to the base: it is sixty paces in length; and at the further end are two large blocks of granite, an obstacle which caused some uncertainty in the digging. A horizontal passage has been made for some distance into the mass of stone; but this undertaking was afterwards abandoned.

"Returning to the extremity of the first gallery, and working upward by the side of the two granite blocks, you come to the beginning of the first sloping stair-case, which proceeds in an oblique direction upward for a hundred and twenty feet. You mount the steep and narrow gallery, helping your steps by notches cut in the ground, and by resting your hands against the sides. At the top of this gallery, which is formed of a calcareous stone cemented with mortar, you find a landing place about fifteen feet square, within which, to the right of the entrance, is a perpendicular opening called the well. This appears, from its irregularity, to have been the result of a fruitless attempt at a search, and has a diameter of about two feet by eighteen inches. There were no means of descending it; but by throwing down a stone, it was ascertained that its perpendicular direction could not be very considerable. On a level with the landing is a horizontal gallery, a hundred and seventy feet in length, running directly towards the centre of the pyramid; and at the extremity of this gallery is a small room, called the Queen's chamber. This is an oblong square of eighteen feet two inches, by fifteen feet eight inches; but the height is uncertain, the floor having been turned up by the avidity of the searchers. One of the side walls has also been worked into, and the rubbish left on the spot. The roof, which is formed of a fine cal-



No. 56.—Pyramids of Dijza.



No. 57.—Entrance to the principal Pyramid of Dijza.

careous stone, very nearly brought together, has the form of an angle nearly equilateral; but contains neither ornament, hieroglyphic, nor the smallest trace of a sarcophagus.—Whether it was intended to contain a body, is uncertain; but, in this case the pyramid must have been built with a view of containing two bodies, and would not therefore have been closed at once. If the second tomb was really that of the queen, the two blocks of granite at the end of the first gallery, must have been finally reserved to close all the interior chambers of the pyramid.

"Returning again from the queen's chamber to the landing place, you ascend a few feet, and immediately find yourself at the bottom of a large and magnificent stair-case, or rather inclined plane, one hundred and eighty feet in length, taking a direction upward, and still bearing towards the centre of the edifice. It is six feet six inches in breadth, in which are to be included two parapets, each nineteen inches in diameter, and pierced every three feet six inches, by oblong holes twenty-two inches by three. The sarcophagus must have ascended this passage, and the series of holes must have been intended to receive a machine of some description, to assist in raising so heavy a mass as the sarcophagus up so steep an ascent.

"The side walls of this ascending gallery rise perpendicularly for twelve feet, and then form a sloping roof of an excessively high pitch, not by a regular angle, but by eight successive projections, each of them six feet in height, rising above the other, and approaching nearer to the corresponding projection on the opposite side, till the roof is entirely shut in. The height of this singularly-contrived vault may be estimated at sixty feet from the part of the floor immediately beneath. The ascent of the staircase is facilitated by pretty regular but modern footings cut in the floor; and at the top is a small platform, in which is a thick block of granite, resembling an immense chest, imbedded in the solid building, and hollowed out so as to leave alternate projections and retirings, into which are let blocks of the same material, with corresponding grooves and projections intended for ever to conceal and protect the entrance to the principal chamber which is behind them. It must have required immense labour to construct this part of the edifice, and not less to have broken

an opening through; so that the zeal of superstition has here been opposed to the eagerness of avarice, and the latter has prevailed. After mining through thirteen feet of solid granite, a door three feet three inches square, has been discovered, which is the entrance to the principal chamber. This is a long square, sixteen feet by thirty-two, and eighteen in height. The door is in the angle facing the gallery, corresponding to the door of the queen's chamber, below. When it is said that the tomb is a single piece of granite, half polished, and without cement, all that is remarkable in this strange monument, which exhibits such rigid simplicity in the midst of the utmost magnificence of human power, will have been described. The only broken part is an attempt at a search at one of the angles, and two small holes nearly round and breast high. Such is the interior of this immense edifice, in which the work of the hand of man appears to rival the gigantic forms of nature."

To the above account by the accurate Denon, we subjoin the following pleasing one by the celebrated Doctor Clarke. The impression made by these monuments, when viewed at a distance, can never, he observes, be obliterated from his mind.

"By reflecting the sun's rays, they appeared as white as snow, and of such surprising magnitude, that nothing we had previously conceived in our imagination had prepared us for the spectacle we beheld. The sight instantly convinced us that no power of description, no delineation, can convey ideas adequate to the effect produced in viewing these stupendous monuments. The formality of their structure is lost in their prodigious magnitude: the mind, elevated by wonder, feels at once the force of an axiom, which, however disputed, experience confirms,—that in vastness, whatsoever be its nature, there dwells sublimity!

"Having arrived at the bottom of a sandy slope, leading up to the principal pyramid, a band of Bedouin Arabs, who had assembled to receive us upon our landing, were much amused by the eagerness excited in our whole party, to prove who should first set his foot upon the summit of this artificial mountain. As we drew near its base, the effect of its prodigious magnitude, and the amazement caused in viewing the enormous masses used in its construction, affected every one of us; but it was an impression of awe and

fear rather than of pleasure. In the observations of travellers who had recently preceded us, we had heard the Pyramids described as huge objects which gave no satisfaction to the spectator, on account of their barbarous shape, and formal appearance: yet to us it appeared hardly possible that persons susceptible of any feeling of sublimity could behold them unmoved. With what amazement did we survey the vast surface that was presented to us, when we arrived at this stupendous monument, which seemed to reach the clouds? Here and there appeared some Arab guides upon the immense masses above us, like so many pigmies, waiting to shew the way up to the summit. Now and then we thought we heard voices, and listened; but it was the wind in powerful gusts, sweeping the immense ranges of stone. Already some of our party had begun the ascent, and were pausing at the tremendous depth which they saw below. One of our military companions, after having surmounted the most difficult part of the undertaking, became giddy in consequence of looking down from the elevation he had attained; and being compelled to abandon the project, he hired an Arab to assist him in effecting his descent. The rest of us, more accustomed to the business of climbing heights, with many a halt for respiration, and many an exclamation of wonder, pursued our way towards the summit. The mode of ascent has been frequently described; and yet, from the questions which are often proposed to travellers, it does not appear to be generally understood. The reader may imagine himself to be upon a staircase, every step of which, to a man of middle stature, is nearly breast high; and the breadth of each step is equal to its height; consequently, the footing is secure; and although a retrospect, in going up, be sometimes fearful to persons unaccustomed to look down from any considerable elevation, yet there is little danger of falling. In some places, indeed, where the stones are decayed, caution may be required; and an Arab guide is always necessary, to avoid a total interruption; but, upon the whole, the means of ascent are such that almost every one may accomplish it. Our progress was impeded by other causes. We carried with us a few instruments; such as our boat-compass, a thermometer, a telescope, &c.; these could not be trusted in the hands of Arabs, and they

were liable to be broken every instant. At length we reached the topmost tier, to the great delight and satisfaction of all the party. Here we found a platform, thirty-two feet square; consisting of nine large stones, each of which might weigh about a ton; although they are much inferior in size to some of the stones used in the construction of this pyramid.

"The view from the summit of the pyramid amply fulfilled our expectations; nor do the accounts which have been given of it, as it appears at this season of the year (in the month of August,) exaggerate the novelty and grandeur of the sight. All the region towards Cairo and the Delta resembled a sea covered with innumerable islands. Forests of palm-trees were seen standing in the water; the inundation spreading over the land where they stood, so as to give them an appearance of growing in the flood. To the north, as far as the eye could reach, nothing could be discerned, but a watery surface thus diversified by plantations and by villages. To the south we saw the pyramids of Saccara; and, upon the east of these, smaller monuments of the same kind, nearer to the Nile. An appearance of ruins might indeed be traced the whole way from the Pyramids of Djiza to those of Saccara; as if they had been once connected, so as to constitute one vast cemetery. Beyond the pyramids of Saccara we could perceive the distant mountains of the Said; and upon an eminence near the Libyan side of the Nile appeared a monastery of considerable size. Towards the west and south-west, the eye ranged over the great Libyan Desert, extending to the utmost verge of the horizon, without a single object to interrupt the dreary horror of the landscape, except dark floating spots, caused by the shadows of passing clouds upon the sand.

"The stones of the platform upon the top, as well as most of the others used in constructing the decreasing ranges from the base upwards, are of soft limestone. Those employed in the construction of the pyramids, are of the same nature as the calcareous rock on which they stand, and which was apparently cut away to form them. Herodotus says, however, that they were brought from the Arabian side of the Nile.

"The French attempted to open the smallest of the three

principal Pyramids; and having effected a very considerable chasm in one of its sides, have left this mark behind them, as an everlasting testimony of their curiosity and zeal. The landing of our army in Egypt put a stop to their labour. Had it not been for this circumstance, the interior of that mysterious monument would probably be now submitted to the inquiry which has long been an object among literary men.

"Having collected our party upon a soft platform before the entrance of the passage leading to the interior, and lighted a number of tapers, we all descended into the dark mouth of the larger pyramid. The impression made upon every one of us, in viewing the entrance, was this: that no set of men whatever could thus have opened a passage, by uncovering precisely the part of the pyramid where the entrance was concealed, unless they had been previously acquainted with its situation; and for these reasons: First, because its position is almost in the centre of one of its planes, instead of being at the base. Secondly, that not a trace appears of those dilapidations which must have been the result of any search for a passage to the interior; such as now distinguish the labours of the French upon the smaller pyramid, which they attempted to open. The persons who undertook the work, actually opened the pyramid in the only point, over all its vast surface, where, from the appearance of the stones inclined to each other above the mouth of the passage, any admission to the interior seems to have been originally intended. So marvellously concealed as this was, are we to credit the legendary story of an Arabian writer, who, discoursing of the wonders of Egypt, attributed the opening of this pyramid to *Almamon*, a Caliph of Babylon, about nine hundred and fifty years since?

"Proceeding down this passage, which may be compared to a chimney about a yard wide, we presently arrived at a very large mass of granite; this seems, to have been placed on purpose to choke up the passage; but a way has been made round it, by which we were enabled to ascend into a second channel, sloping, in a contrary direction, towards the mouth of the first. Having ascended along this channel, to the distance of one hundred and ten feet, we came to a horizontal passage, leading to a chamber with an angular roof, in the interior of the pyramid. In this passage

we found, upon our right hand, the mysterious well, which has been so often mentioned. Pliny makes the depth of it equal to one hundred and twenty-nine feet; but Greaves, in sounding it with a line, found the plummet rest at the depth of twenty feet.

"We threw down some stones, and observed that they rested at about the depth which Greaves has mentioned; but being at length provided with a stone nearly as large as the mouth of the well, and about fifty pounds in weight, we let this fall, listening attentively to the result from the spot where the other stones rested: we were agreeably surprised by hearing, after a length of time which must have equalled some seconds, a loud and distinct report, seeming to come from a spacious subterraneous apartment, accompanied by a splashing noise, as if the stone had been broken in pieces, and had fallen into a reservoir of water at an amazing depth. Thus does experience always tend to confirm the accounts left us by the Ancients; for this exactly answers to the description given by Pliny of this well.

"After once more regaining the passage whence these ducts diverge, we examined the chamber at the end of it, mentioned by all who have described the interior of this building. Its roof is angular; that is to say, it is formed by the inclination of large masses of stone leaning towards each other, like the appearance presented by those masses which are above the entrance to the pyramid. Then quitting the passage altogether, we climbed the slippery and difficult ascent which leads to what is called the principal chamber. The workmanship, from its perfection, and its immense proportions, is truly astonishing. All about the spectator, as he proceeds, is full of majesty, and mystery, and wonder. Presently we entered that 'glorious roome,' as it is justly called by Greaves, where, 'as within some consecrated oratory, Art may seem to have contended with Nature.' It stands 'in the very heart and centre of the pyramid, equidistant from all its sides, and almost in the midst between the basis and the top. The floor, the sides, the roof of it, are all made of vast and exquisite tables of Thebaick marble.' So nicely are these masses fitted to each other upon the sides of the chamber, that, having no cement between them, it is really impossible to force the blade of a knife within the joints. This has been often related before;

but we actually tried the experiment, and found it to be true. There are only six ranges of stone from the floor to the roof, which is twenty feet high; and the length of the chamber is about twelve yards. It is also about six yards wide. The roof or ceiling consists of only nine pieces, of stupendous size and length, traversing the room from side to side, and lying, like enormous beams, across the top."

Mr. Salt, the traveller, having paid a recent visit to the principal pyramid, in company with a British officer, it has been ascertained that the short descending passage at its entrance, which afterwards ascends to the two chambers, is continued in a straight line through the base of the pyramid into the rock on which it stands. This new passage, after joining what was formerly called the well, is continued forward in a horizontal line, and terminates in a well, ten feet in depth, exactly beneath the apex of the pyramid, and at the depth of one hundred feet beneath its base.—Mr. Salt's companion has likewise discovered an apartment immediately above the king's chamber, exactly of the same size, and of the same fine workmanship, but only four feet in height.

The base of the pyramid of Cephrenes, the next in magnitude, of the pyramids of Djiza, to that of Cheops, is estimated at 655 feet, and its height at 398. The pyramid of Miserinus has a base of 280 feet, and an elevation of 162.

The pyramids of Saccara, which are numerous, are interesting on account of the peculiarities of their structure. —[*See Plate, No.* 59.]—The largest of them is of an irregular form, the line of the terminating angle being sloped like a buttress reversed. Another, of a middling size, is composed of stages rising one above another. The smaller ones are greatly decayed; but the whole occupy an extent of two leagues. This multitude of pyramids scattered over the district of Saccara, Denon observes, prove that this territory was the *Necropolis* (city of the dead) to the south of Memphis, and that the village opposite to this, in which the pyramids of Djiza are situated, was another Necropolis, which formed the northern extremity of Memphis.—The extent of that ancient city may thus be measured.

THE SPHYNX.

At an inconsiderable distance from the great Egyptian pyramids, and by an almost imperceptible descent, the traveller arrives at the Sphynx, the enormous bulk of which instantly attracts his attention. It is cut out of the solid rock, and is said to have been the sepulchre of Amasis. The height of this figure is twenty-seven feet; and the beginning of the breast thirty-three feet in width. The nose has been shamefully mutilated. "Although," Denon remarks, "the proportions are colossal, the outline is pure and graceful; the expression is mild, gracious, and tranquil; the character is African; but the mouth, the lips of which are thick, has a softness and delicacy of execution truly admirable; it seems real life and flesh. Art must have been at a high pitch when this monument was executed; for, if the head is deficient in what is called *style*, that is the straight and bold lines which give expression to the figures under which the Greeks have designated their deities, yet sufficient justice has been rendered to the fine simplicity and character of nature displayed in this figure."

EGYPTIAN TEMPLES AND MONUMENTS.

The ruins of the Temple of Hermopolis, or the great city of Mercury, afford a precise idea of the immense range and high perfection the arts had attained in Egypt. The stones have preserved their original destination, without having been altered or deformed by the works of modern times, and have remained untouched for four thousand years! They are of freestone, of the fineness of marble, and have neither cement, nor mode of union, besides the perfect fitting of the respective parts. The colossal proportions of this edifice evince the power the Egyptians possessed to raise enormous masses. The diameter of the columns, which are placed at equal intermediate distances, is 8 feet 10 inches; and the space between the two middle columns, within which the gate was included, twelve feet, which gives 120 feet for the portico: its height is 60 feet. Not any spring of an arch remains to throw light on the dimensions of the whole extent of the temple, or of the nave.

The architecture is still richer than the doric order of the Greeks. The shafts of the pillars represent *fasciae*, or bundles; and the pedestal, the stem of the lotus. Under the roof between the two middle columns, are winged globes; and all the roofs are ornamented with a wreath of painted stars, of an aurora colour on a blue ground.

THE TEMPLE OF APOLLINOPOLIS MAGNA is described by Denon as surpassing in extent, majesty, magnificence, and high preservation, whatever he had seen in Egypt, or elsewhere. This building is a long suite of pyramidal gates, of courts decorated with galleries, of porticoes, and of covered naves, constructed, not with common stones, *but with entire rocks*. This superb edifice is situated on a rising ground, so as to overlook, not only its immediate vicinity, but the whole valley. On the right is the principal gate, placed between two huge mounds of buildings, on the walls of which are three orders of hieroglyphic figures increasing in their gigantic dimensions, insomuch that the last have a proportion of twenty-five feet. The inner court is decorated with a gallery of columns, bearing two terraces, which come out at two gates, through which is the passage to the stairs, leading to the platform of the mounds. Behind the inner portico are several apartments, and the sanctuary of the temple. A wall of circumvalation is decorated both within and without with innumerable hieroglyphics, executed in a very finished and laborious style. This magnificent temple appears to have been dedicated to the evil genius, the figure of Tryphon being represented in relief on the four sides of the plinth which surmounts each of the capitals. The entire freize, and all the paintings within, are descriptive of Isis defending herself against the attacks of that monster.

The ruins of the ancient city of THEBES, which Homer has characterised by the single expression of THE CITY WITH A HUNDRED GATES, are of so immense an extent as to convince the spectator that fame has not magnified its size; for, the diameter of Egypt not being sufficient to contain it, its monuments rest on two chains of contiguous mountains, while its tombs occupy the vallies towards the west, far on into the desert. A large temple on the eastern side is more than two leagues and a half distant from Medinet-Abu, where the most western temple is situated. The modern village of Karnac is built on a small part of the site of a

single temple, which requires half a mile to walk round. The remains of this temple are thus described by Denon.

"Of the hundred columns of the portico alone, the smallest are seven feet and a half in diameter, and the largest twelve. The space occupied by the circumvallation of the temple contains lakes and mountains. In short, to be enabled to form a competent idea of so much magnificence, the reader ought to fancy what is before him to be a dream, as he who views the objects themselves rubs his eyes to know whether he is awake. The avenue leading from Karnac to Luxor, a space nearly half a league in extent, contains a constant succession of sphynxes and other chimerical figures to the right and left, together with fragments of stone walls, of small columns, and of statues."

The village of Luxor is also built on the side of the ruins of a temple, not so large as that of Karnac, but in a better state of preservation, the masses not having as yet fallen through time, and by the pressure of their own weight. The most collossal parts consist of fourteen columns of nearly eleven feet in diameter, and of two statues in granite, at the outer gate, buried up to the middle of the arms, and having in front of them the two largest and best preserved obelisks known. The French, when in Egypt, deemed their means insufficient, not to hew out, but merely to transport these two monuments, which are not more than a fragment of one of the numerous edifices of the astonishing city of Thebes. They are of rose-colour granite, are still seventy feet above the ground, and to judge by the depth to which the figures seem to be covered, about thirty feet more may be reckoned to be concealed from the eye, making in all one hundred feet for their height. Their preservation is perfect; and the hieroglyphics with which they are covered being cut deep, and in relief at the bottom, show the bold hand of a master, and a beautiful finish. The gravers which could touch such hard materials must have been of an admirable temper; and the machines to drag such enormous blocks from the quarries, to transport them thither, and to set them upright, together with the time required for the labour, surpass all conception!

In speaking of the gate of the temple, which is now become that of the village of Luxor, Denon remarks as follows. "Nothing can be more grand, and at the same time

more simple, than the small number of objects of which this entrance is composed. No city whatever makes so proud a display at its approach as this wretched village, the population of which consists of two or three thousand souls, who have taken up their abode on the roofs and beneath the galleries of this temple, which has, nevertheless, the air of being in a manner uninhabited.

THE TOMBS OF THE KINGS OF THEBES are grottoes consisting of a regular double gallery supported by pillars, behind which is a row of chambers, often double. In proportion as the height of these grottoes increase, they become more richly decorated; and the spectator is soon convinced, by the magnificence both of the paintings and sculptures, and of the subjects they represent, that he is among the tombs of great men or heroes. Those which appear to have belonged to the ancient kings, are only distinguished from the others by the magnificence of the sarcophagi, and the mysterious solitude of their situation; the others immediately overlooking the great buildings in the city. The sculpture in all is incomparably more laboured and higher finished than that of the temples, and displays a high perfection of the art. The lines of the hieroglyphics have been cut with a firmness of touch, and a precision, of which marbles offer but few examples; and the figures have a particular elegance and correctness of contour. Small subjects taken from nature are introduced; and in these the groups of persons are given in perspective; and cut in deep relief, in simple and natural attitudes. Several of these subjects bear but little analogy to the spot in which they are immured; for bass-reliefs are seen representing games, such as rope-dancing, and asses taught to play tricks and rear on their hind legs, sculptured with all the traits of genuine nature and simplicity.

The plan of these excavations is singular; and many are so vast and complicated, that they might be mistaken for labyrinths, or subterraneous temples. After passing the elegant apartments described above, long and gloomy galleries present themselves, winding backwards and forwards in numerous angles, and seeming to occupy a great extent of ground. They are melancholy, repulsive, and without any decoration; but open from time to time into other chambers covered with hieroglyphics, and branch out

into narrow paths, leading to deep perpendicular pits. At the bottom of these pits are other adorned chambers; and lower still a new series of perpendicular pits and horizontal chambers, until at length, ascending a long flight of steps, the visitor reaches an open place on a level with the chambers he first entered.

The ancient Latopolis, now called Esneh, presents, among its remains, the portico of a temple which is considered as one of the most perfect monuments of ancient architecture. It is very well preserved, and possesses a great richness of sculpture. It is composed of eighteen noble and elegant columns, with broad capitals; and the hieroglyphics in relief with which it is covered withinside and without, have been executed with great care. They contain among other subjects, a zodiac, and large figures of men with crocodiles' heads. The capitals, though all different, have a very fine effect; and, as a proof that the Egyptians did not borrow from other nations, it may be remarked, that all the ornaments of which these capitals are composed, have been taken from the productions of their own country, such as the lotus, the palm tree, the vine, the rush, &c.

CRYPTÆ, OR CATACOMBS OF ALEXANDRIA.

In the construction of these primeval sepulchres a prodigious labour has been bestowed. They are situated about half a league along the shore, to the westward of the modern city of Alexandria. Their intricacy is such that the guides will not enter them without being provided with a clue of thread, to secure their retreat. Doctor Clarke has been very particular in his description of these subterraneous abodes of the dead; and from his interesting narrative the following particulars are extracted.

"The original entrance to them is now closed, and is externally concealed from observation. The only place by which admittance to the interior is practicable, is a small aperture made through the soft and sandy rock, barely large enough to admit a person upon his hands and knees. Here it is not unusual to encounter jackals, escaping from the interior, when alarmed by any person approaching: on this account the guides recommend the practice of discharging a gun, or pistol, to prevent any sally of this kind. Having passed this aperture with lighted tapers, we arrived, by gradual



No. 59.—Remarkable form of one of the Pyramids of Saccara.



No. 60.—Stonehenge.



No. 61.—View of Palmyra.



No. 62.—St. Peter's of Rome.

the middle, between the two, a long range of chambers extended from the central and circular shrine towards the north-west; and in this direction appears to have been the principal and original entrance. Proceeding towards it we came to a large room in the middle of the fabric, between the supposed Serapeum and the main outlet, or portal, towards the sea. Here the workmanship was very elaborate; and to the right and left were chambers, with receptacles ranged parallel to each other. Farther on, in the same direction, is a passage with galleries and spacious apartments on either side; probably the chambers for embalming the dead, or those belonging to the priests, who constantly officiated in the Serapeum. In the front is a kind of vestibulum, or porch: but it is exceedingly difficult to ascertain precisely the nature of the excavation towards the main entrance, from the manner in which it is now choked with earth and rubbish. If this part were laid open, it is possible that something further would be known as to the design of the undertaking; and, at all events, one of the most curious of the antiquities of Egypt would then be exposed to the investigation it merits. Having passed about six hours in exploring, to the best of our ability, these gloomy mansions, we regained, by means of our clue, the aperture by which we had entered, and quitted them for ever."

RUINS OF PALMYRA.

[*See Plate, No.* 61.]

This noble city of ancient Syria, also called Tadmor, is of uncertain date and origin, but is thought by many to have been THE TADMOR IN THE WILDERNESS, built by Solomon. Its splendid ruins consist of temples, palaces, and porticoes of Grecian architecture, scattered over an extent of several miles. The most remarkable of them is the Temple of the Sun, the ruins of which are spread over a square of 220 yards. It was encompassed with a stately wall, built of large square stones, and adorned with pilasters within and without, to the number of 62 on each side. Within the court are the remains of two rows of very noble marble pillars 37 feet high, with their capitals of most exquisite workmanship. Of these 58 only remain entire; but there must have been many more, for they appear to have surrounded the whole

court, and to have supported a double piazza. The walks on the side of the piazza opposite to the front of the castle seem to have been the most spacious and beautiful. At the end of this line are two niches for statues, with their pedestals, borders, supporters, and canopies, carved with the utmost elegance. The space within the inclosure appears to have been an open court, in the centre of which stood the temple, encompassed with another row of pillars of a different order, and much taller, being 50 feet in height; of these 16 only remain. The whole space contained within these pillars is 59 yards in length, and nearly 28 in breadth. The temple which points north and south, is 33 yards in length, and 13 or 14 in breadth. At its centre, on the west side, is a most magnificent entry, on the remains of which vines and clusters of grapes are carved in the most bold and masterly imitation of nature that can be conceived. Over the door was displayed a pair of wings extending its whole breadth; but the body to which they belonged is totally destroyed, so that it cannot certainly be known, whether it was that of an eagle or of a cherub, several representations of both being visible on other fragments of the building. Its north extremity is adorned with the most curious fret-work and bass-relief; and in the centre is a dome or cupola, about 10 feet in diameter, which appears to have been either hewn out of the rock, or moulded of some composition which by time has become equally hard. North of this place is an obelisk, consisting of seven large stones, besides its capital, and the wreathed work about it. It probably, supported a statue, which the Turks, in their zeal against idolatry, have destroyed. At the distance of a quarter of a mile from this pillar, to the east and west, are two others, besides the fragment of a third, so as to lead to the supposition that there was originally a continued row.

About 100 paces from the middle obelisk, straight forward, is a magnificent entry to a piazza, 40 feet in breadth and more than half a mile in length, inclosed with two rows of marble pillars 26 feet high, and 8 or 9 feet in compass. Of these there still remain 129; and by a moderate computation, there could not have been originally less than 560. The upper end of this piazza was shut in by a row of pillars, standing somewhat closer than those on each side. A little to the left are the ruins of a stately building, which

appears to have been a banqueting house: it is built of better marble, and is finished with still greater elegance than the piazza. The pillars by which it was supported were of one entire stone, so strong that one of them which has fallen down has not received the slightest injury. It measures 23 feet in length; and in compass 8 feet 9 inches. At the west side of the piazza are several apertures for gates into the court of the palace, each of them ornamented with four porphyry pillars, not standing in a line with those of the wall, but placed by couples in the front of the gate facing the palace, two on each side. Two of these only remain entire, and one only standing in its place. They are 30 feet in length, and nine in circumference. On the east side of the piazza stand a great number of marble pillars, some perfect, but the greater part mutilated. In one place 11 of them are ranged in a square, the space they inclose being paved with broad flat stones, but without any remains of a roof. At a little distance are the remains of a small temple, also without a roof, and having its walls much defaced. Before the entry, which faces the south, is a piazza supported by six pillars, two on each side of the door, and one at each end. The pedestals of those in front have been filled with inscriptions, both in Greek and Palmyrene languages, which are become totally illegible. Among these ruins are many sepulchres, ranged on each side of a hollow way towards the north part of the city, and extending more than a mile. They are square towers, four or five stories high, alike in form, but differing in magnitude and splendour. The outside is of common stone; but the floors and partitions of each story are of marble. A walk crosses the centre of this range of buildings, and the space on each side is subdivided by thick walls, into six partitions, the space between which is wide enough to receive the largest corpse. In these niches six or seven are piled on one another.

RUINS OF BALBEC.

These magnificent ruins are described by Mr. Bruce as even surpassing what he had seen at Palmyra. He was particularly struck by the splendid vestiges of the great temple, supposed to have been dedicated to the sun. The castle of Balbec, or tower of Lebanon, is described by Father Leander, of the order of bare-footed Carmelites, in his inter-

ending travels, as a surprising monument of antiquity, built, according to the tradition of the natives, by Solomon.— His relation is as follows.

"Balbec is distant from Damascus, towards the north, about fifty miles, and on the southern side is watered by springs and rivulets, brought thither, no doubt, to fill the ditches by which it was to have been surrounded for defence, but which were not completed. It is situated on the lofty summit of a hill, in approaching which the façade of the castle is seen, having two towers at its right angles, between which is a great portico, resembling the mouth of a vast cave, and provided with very strong walls. That on the right hand, by which the portico is attached to the tower, from the west to the north, is composed of four stones only, the fifth, which was to have completed the fabric, being deficient. The length of each of these stones is not less than sixty-two feet, and their breadth and height thirteen. They are so artfully brought together, without any cement, that they appear to be only one solid block. The remainder of the wall to the left is of hewn stones, well cemented with quick lime, the smallest of which are 6 feet in length, and 4 feet six inches in height: there are many which are upwards of fifteen feet in length, but the height of all of them is the same.

"Having entered the cavern by the grand portico, the traveller proceeds in obscurity to the distance of eighteen paces, when he at length perceives a ray of light proceeding from the aperture of the door which conducts to the centre. At each of the sides, and within this grand portico, is a flight of stone steps which leads to the subterraneous prisons. Their aspect is horrid, and they are dangerous, inasmuch as they are wont to be frequented by banditties of robbers, who here plunder, kill, and bury such wretched travellers as are imprudently led by their curiosity to penetrate, and risk the descent without being well escorted. Following the road above, by the cavern, to the extent of fifty paces, an ample area of a spherical figure presents itself, surrounded by majestic columns of granite, some of them of a single piece, and others formed of two pieces, the whole of them of so large a dimension, that two men can with difficulty girt them. They are of the Ionic order of architecture, and are placed on bases of the same stone, at such distances from

each other that a coach and six might commodiously turn between them. They support a flat tower or roof, which projects a cornice wrought with figures of matchless workmanship: these rise above the capitals with so nice an union, that the eye however perfect it may be, cannot distinguish the part in which they are joined. At the present time the greater part of this colonnade is destroyed, the western part alone remaining perfect and upright. This fabric has an elevation of 500 feet, and is 400 feet in length. In its exterior, and behind, it is flanked by two other towers similar to those of the first façade, the whole projecting from the wall, which withinside is provided with loop holes, to keep off the enemy, in case of necessity, by the means of stones, fire, &c. It also surrounds the colonnade, more particularly in the part which looks towards the east. At the left flank rises a temple, which tradition says was the hall of audience of Solomon, in height at least 80 feet, and long and large in proportion. Its stones are all sculptured with bass-reliefs, similar to those which ornament Trajan's column at Rome, representing many triumphs and naval engagements. Several of these bass-reliefs have been defaced by the Saracens, who are the decided enemies of all sculptures. Withoutside this grand hall is an avenue of the same size and breadth, where the traveller admires a large portal constructed with three stones only, attached to which, in the middle part, serving as an architrave, is seen, in a garland of laurel interwoven with flowers, a large eagle admirably sculptured in bass-relief. At the sides of the portal are placed two columns, in one of which, although formed of a single stone, is a winding staircase by which to ascend to the architrave: the passage is however very narrow. There is in the vicinity another temple, of an octangular shape, with a portico of superb architecture, and having three windows on the side opposite to the former."

On a large stone are inscribed these words in Latin: *Diviso Mosei*, on which Father Leander confesses he knows not what interpretation to bestow. Thrice he returned to visit this splendid vestige of antiquity; and on the last of these occasions, being well escorted, he proceeded to the distance of about a mile, to the foot of the mountains of Damascus, whence the stones employed in its construction were brought. He measured the stone which remained

there, and which has been already noticed as having been intended for the fifth in the construction of the wall: it had been hewn out on all sides, was lying on the ground, and was simply attached to the rock at the inferior part. Its length and dimensions were such, that he could not conceive how it would have been possible to detach it, and still less with what machines to move, transport, and raise it to the height at which the other stones are placed, more especially as the sites, the roads, and the masses of rock are such, as to exceed in asperity whatever the imagination can picture to itself. In the vicinity of the cave whence these stones were drawn, is a very beautiful sepulchre supported by columns of porphyry, over which is a dome of the finest symmetry.

RUINS OF BABYLON.

[*See Plates, No.* 63, 64, 65.]

These ruins are to be regarded as the most interesting productions of man, as well on account of their paramount antiquity, as of all the associations connected with them. They have been visited and described by Mr. Rich, resident for the East India company at Bagdad; and the result of his researches is given by the Rev. Mr. Maurice, Author of Indian Antiquities, and Assistant Librarian to the British Museum, in his elaborate work entitled "Observations connected with Astronomy and Ancient History, sacred and profane, on the Ruins of Babylon."

Babylon was situated in a plain of vast extent, and bisected by the noble river Euphrates. Over this river was thrown a bridge of massy masonry, strongly compacted with iron and lead, by which the two sides of the city were connected; and the embankments on each side, to restrain its current, were lofty, and formed of the same durable materials as the walls of the city. The city itself is represented by Herodotus to have been a perfect square, enclosed by a wall in circumference four hundred and eighty furlongs. It is stated to have abounded in houses three or four stories in height, and to have been regularly divided into streets, running parallel to each other, with tranverse avenues occasionally opening to the river. It was surrounded with a wide and deep trench, the earth dug out of which was formed into square bricks and baked in a furnace. With

these, cemented together with *heated-bitumen*, intermixed with *reeds* to bind the viscid mass, the sides of the trenches were lined; and of the same solid materials the walls of the vast dimensions above described were formed: At certain regular distances on them, watch towers were erected; and below they were divided and adorned with a hundred massy gates of brass.

In the centre of each of the grand divisions of the city, a stupendous public fabric was erected. In one (the *eastern* side) stood the temple of Belus; and in the other, (or *western* division) in a large or strongly fortified inclosure, the royal palace, intended, doubtless, for defence as well as for ornament. The temple of Belus was a square pile, on each side of the extent of two furlongs. The tower erected in its centre was a furlong in breadth, and as much in height, the latter of which (taking the furlong at only 500 feet) is enormous, being higher, by 20 feet, than the great pyramid of Memphis, whose altitude was taken by Greaves. On this tower, as a BASE, seven other lofty towers were erected in regular succession; and the whole was crowned, according to Diodorus, with a brazen statue of the good BELUS, 40 feet high! The palace, intended also as a citadel, was erected on an area a mile and a half square, and was surrounded with three vast circular walls, which, as we are informed by Diodorus Siculus, were ornamented with sculptured animals resembling life, richly painted in their natural colours on the bricks of which they were composed, and *afterwards burnt in*. This may be mentioned as nearly the earliest specimen of *enamelling* on record. Indeed, it was scarcely possible for a nation, who were so well practised in the burning of bricks even to a vitreous hardness, to have been ignorant of this fine art, and that they could also *engrave* upon them, is evident (were such evidence wanting) from the characters at this day sculptured upon those that have been dug up and brought to Europe, two of which are preserved in the British Museum. On the far-famed hanging gardens, and the subterraneous vault or tunnel constructed by Semiramis, or Nitocris, or the founder of Babylon, whoever he was, there is no necessity to dilate, as every trace of them, except what the idle fancy of travellers has surmised, must long since have disappeared; but such, in its general outline, was THE MIGHTY BABYLON.

Mr. Rich, whose residence at the court of Bagdad, and the powerful protection of the Pacha, afforded him every facility for comprehensive investigation, describes the whole country between Bagdad and Hella, a distance of 48 miles, as a perfectly flat, and, for the greater part, uncultivated waste; though it is evident, from the number of canals by which it is traversed, and the immense ruins that cover its surface, that it must formerly have been both well peopled and cultivated. About two miles above Hella, the more prominent ruins commence, among which, at intervals, are discovered, in considerable quantities, *burnt* and *unburnt bricks* and *bitumen;* two vast mounds in particular attract attention from their size, and these are situated on the eastern bank of the Euphrates. There are scarcely any remains of ruins visible, immediately opposite on the western bank, but there are some of a stupendous magnitude on that side, about six miles to the south-west of Hella.

The first grand mass of ruins described by Mr. Rich, extends one thousand one hundred yards in length, and eight hundred in its greatest breadth, its figure nearly resembling that of a quadrant; its height is irregular; but the most elevated part may be about fifty or sixty feet above the level of the plain, and it has been dug into for the purpose of procuring bricks. On the north is a valley of 550 yards in length, the area of which is covered with tussocks of rank grass, and crossed by a line of ruins of very little elevation. To this succeeds the second grand heap of ruins, the shape of which is nearly a square, of seven hundred yards length and breadth, and having its S. W. angle connected with the N. W. angle of the mounds of Amran, by a ridge of considerable height, and nearly 100 yards in breadth. This is certainly the most interesting part of the ruins of Babylon; every vestige discoverable in it declares it to have been composed of buildings far superior to all the rest which have left traces in the eastern quarter: the bricks are of the finest description; and, notwithstanding this is the grand storehouse of them, and that the greatest supplies have been and are now constantly drawn from it, they appear still to be abundant. But the operation of extracting the bricks has caused great confusion, and contributed much to increase the difficulty of decyphering the original design of this mound, as, in search of them, the workmen pierce into it in

every direction, hollowing out deep ravines and pits, and throwing up the rubbish in heaps on the surface. In some places they have bored into the solid mass, forming winding caverns and subterraneous passages, which from their being left without adequate support, frequently bury the workmen in the rubbish. In all these excavations, walls of burnt brick, laid in lime mortar of a very good quality are seen; and, in addition to the substances generally strewed on the surfaces of all these mounds, we here find fragments of *alabaster vessels, fine earthenware, marble, and great quantities of varnished tiles, the glazing and colouring of which are surprisingly fresh.* In a hollow near the southern part Mr. Rich found a sepulchral urn of earthenware, which had been broken in digging, and near it lay some human bones, which pulverized with the touch.

Not more than two hundred yards from the northern extremity of the above mound is a ravine hollowed out by those who dig for bricks, in length nearly a hundred yards, and thirty feet wide, by forty or fifty deep. On one side of it a few yards of wall remain standing, the face of which is very clean and perfect, and which appears to have been the front of some building. The opposite side is so confused a mass of rubbish, that it should seem the ravine had been worked through a solid building. Under the foundations at the southern end an opening is made, which discovers a subterraneous passage seven feet in height, and winding to the south, floored and walled with large brick, laid in bitumen, and covered over with pieces of sand-stone, a yard thick, and several yards long, on which the whole pressure is so great as to have given a considerable degree of obliquity to the side walls of the passage. The superstructure is cemented with bitumen, other parts of the ravine with mortar, and the bricks have all *writing on them.* The northern end of the ravine appears to have been crossed by an extremely thick wall of yellowish brick, cemented with a brilliant white mortar, which has been broken through in hollowing it out: and a little to the north is sculptured *a lion of colossal dimensions,* standing on a pedestal, of a coarse kind of grey granite, and of rude workmanship; in the mouth is a circular aperture, into which a man may introduce his fist.

The next considerable mass to that of Amran is the Kasr, or Palace, as it is called by the natives, and it is thus described by Mr. Rich.

"It is a very remarkable ruin, which, being uncovered, and in part detached from the rubbish, is visible from a considerable distance, but so surprisingly fresh in its appearance, that it was only after a minute inspection I was satisfied of its being in reality a Babylonian remain. It consists of several walls and piers, (*which face the cardinal points,*) eight feet in thickness, in some places ornamented with niches, and in others, strengthened by pilasters and buttresses, built of fine burnt brick, (still perfectly clean and sharp,) laid in lime cement, of such tenacity, that those whose business it is have given up working, on account of the extreme difficulty of extracting them whole. The tops of these walls are broken, and may have been much higher. On the outside, they have in some places been cleared nearly to the foundations; but the internal spaces, formed by them, are yet filled with rubbish, in some parts almost to their summit. One part of the wall has been split into three parts, and overthrown, as if by an earthquake; some detached walls of the same kind, standing at different distances, show what remains to have been only a small part of the original fabric; indeed, it appears that the passage in the ravine, together with the wall which crosses its upper end, were connected with it. There are some hollows underneath, in which several persons have lost their lives; so that no one will now venture into them, and their entrances have become choked up with rubbish. Near this ruin is a heap of rubbish, the sides of which are curiously streaked by the alternation of its materials, the chief part of which, it is probable, was unburnt brick, of which I found a small quantity in the neighbourhood; but no reeds were discoverable in the interstices.

"A mile to the north of the Kasr, or full five miles distant from Hella, and 950 yards from the river bank, is the last ruin of this series, which has been described by Pietro Della Valle, who determines it to have been the Tower of Belus, an opinion adopted by Rennel. The natives call it Mukallibe, or, according to the vulgar Arab pronunciation of these parts, Mujelibe, meaning overturned; they sometimes also apply this term to the mounds of the Kasr. It is of an oblong shape, irregular in its height and the measurement of its sides, *which face the cardinal points;* the northern side being 200 yards in length, the southern 219,

the eastern 182, and the western 136; the elevation of the south-east, or highest angle, 141 feet. The western face, which is the least elevated, is the most interesting, on account of the appearance of building it presents. Near the summit of it appears a low wall, with interruptions, built of unburnt bricks, mixed up with chopped straw or reeds, and cemented with clay-mortar of great thickness, having between every layer a layer of reeds; and on the north-side are also some vestiges of a similar construction. The south-west angle is crowned by something like a turret, or lantern: the other angles are in a less perfect state; but may originally have been ornamented in a similar manner. The western face is lowest and easiest of ascent, the northern the most difficult. All are worn into furrows by the weather; and in some places, where several channels of rain have united together, these furrows are of great depth, and penetrate a considerable way into the mound. The summit is covered with heaps of rubbish, in digging into some of which, layers of broken burnt brick, cemented with mortar, are discovered, and whole bricks, with inscriptions on them, are here and there found; the whole is covered with innumerable fragments of pottery, brick, bitumen, pebbles, vitrified brick, or scoria, and even shells, bits of glass, and mother of pearl."

Mr. Rich having now finished his observations on the ruins of the east bank of the Euphrates, enters upon the examination of what, on the opposite west bank, have been by some travellers supposed, (and their suppositions have been adopted by Major Rennel,) to be the remains of this great city. Those, however, which Mr. Rich describes, are of the most trifling kind, scarcely exceeding one hundred yards in extent, and wholly consisting of two or three insignificant mounds of earth, overgrown with rank grass. The country too being marshy, he doubts the *possibility* of there having been any buildings of considerable magnitude erected in that spot, and, much less, buildings of the astonishing dimensions of those described by the classical writers of antiquity. He then opens to our view a new and almost unexplored remain of ancient grandeur, in the following passage:

"But, although there are not any ruins in the immediate vicinity of the river, by far the most stupendous and sur-

Ruins of Babylon.



No. 63.—The Birs Nimroud.



No. 64.—The Kasr.



No. 65.—The Mujelibe.

prising mass of all the remains of Babylon is situated in the desert about six miles to the south-west of Hella. It is called by the Arabs *Birs Nimrod,* by the Jews, *Nebuchadnezzar's Prison.* It is a mound of an oblong figure, the total circumference of which is seven hundred and sixty-two yards. At the eastern side it is cloven by a deep furrow, and is not more than fifty or sixty feet high; but at the western it rises in a conical figure to the elevation of one hundred and ninety-eight feet; and on its summit is a solid pile of brick, thirty-seven feet high by twenty-eight in breadth, diminishing in thickness to the top, which is broken and irregular, and rent by a large fissure extending through a third of its height. It is perforated by small square holes, disposed in rhomboids. The fine *burnt bricks of which it is built have inscriptions on them;* and so admirable is the cement, which appears to be lime-mortar, that, though the layers are so close together that it is difficult to discern what substance is between them, it is nearly impossible to extract one of the bricks whole. The other parts of the summit of this hill are occupied by immense fragments of brick-work, of no determinate figure, tumbled together and converted into *solid vitrified masses,* as if they had undergone the action of the fiercest fire, or been blown up with gunpowder, the layers of the bricks being perfectly discernible,—a curious fact, and one for which I am utterly incapable of accounting.

"Round the Birs are traces of ruins to a considerable extent. To the north is the canal which supplies Mesjiid Ali with water, which was dug at the expence of the Nuwaub Shujahed Doulah, and called after his country, Hindia. We are informed that, from the summit of the Birs, in a clear morning, the gilt dome of Mesjiid Ali may be seen."

BABYLONIAN BRICKS.

The most ancient method of writing was on *stone* or *brick,* of which, as the earliest example on record, if allowable to be cited, may be adduced that of the two pillars of Seth, the one of *brick* and the other of *stone,* said by Josephus to have been erected before the deluge, and to have contained the history of antediluvian arts and sciences.—However disputable this account may be, that of *the table*

of stone on which the decalogue was written by the finger of the Deity, and delivered to Moses on Mount Sinai, can admit of no doubt, no more than can the hieroglyphic characters in the most ancient periods, *engraved* on the marbles of Egypt, at present so abundant in the collections of Europe. They remain to this day, and will be, for centuries to come, a lasting proof of the high advance in the *engraving* art, as well as in *chemical* science, of a nation, who, at that early period, could fabricate instruments to cut them so deep and indelibly on the almost impenetrable granite.

In countries destitute of stone, like Chaldæa, an artificial substance, CLAY, intermixed with reeds, and indurated by fire, was made use of for that purpose. Of this substance, formed into square masses, covered with mystic characters, the walls and palaces of Babylon were, for the most part, constructed: and it has been seen in the accounts of travellers who have visited these ruins, examined the bricks, and observed those reeds intermingled with their substance, how durable, through a vast succession of ages, those bricks, with their inscribed characters, have remained.—Their real meaning, or that of the Persepolitan arrow-headed obelistical characters, and the still more complicated hieroglyphics of Egypt, however partially decyphered by the labours of the learned, will, perhaps, never be fathomed in their full extent, by the utmost ingenuity of man.

Of the *bitumen* with which these Babylonian bricks were cemented together, and which was plentifully produced in the neighbourhood of Babylon, it may be proper in this place to remark, that it binds stronger than mortar, and in time becomes harder than the brick itself. It was also impenetrable to water, as to the early descendants of Noah was well known, for both the outside and the inside of the ark was incrusted with it. Gen. vi. 14. It may be proper to add here, that the bitumen, to deprive it of its brittleness, and render it capable of being applied to the brick, must be boiled with a certain proportion of oil, and that it retains its tenacity longest in a humid situation. Mr. Rich informs us, that it is, 'at present, principally used for caulking boats, coating cisterns, baths, and other places which usually come in contact with water. The fragments of it scattered over the ruins of Babylon are black, shining, and brittle, somewhat resembling pit-coal in substance and appearance.'

It will not be forgotten, that the custom, above alluded to of mixing straw or reeds with bricks baked in the sun, in order to bind them closer, and to make them more firm and compact, was also used in Egypt, as may be inferred from Exodus v. 7, where Pharaoh commands the task-masters of the oppressed Israelites *not to give them straw to make bricks*, in order to multiply their vexations, and increase their toil.

Speaking of the Babylonian bricks, and their variety, in respect to *size*, *colour*, and *hardness*, Mr. Rich informs us, that "the general size of the *kiln-burnt* brick is thirteen inches square, by three thick: there are some of half these dimensions, and a few of different shapes for particular purposes, such as rounding corners, &c. They are of several different colours; *white*, approaching more or less to a yellowish cast, like our Stourbridge, or fire-brick, which is the finest sort; *red*, like our ordinary brick, which is the coarsest sort; and some which have a *blackish* cast, and are very hard. The sun-dried brick is considerably larger than that baked in the kiln, and in general looks like a thick clumsy clod of earth, in which are seen small broken reeds, or chopped straw, used for the obvious purpose of binding them: in like manner the flat roofs of the houses of Bagdad are covered with a composition of earth and mortar, mixed up with chopped straw." At the Birs Nemroud, Mr. Rich found some fire-burnt bricks, which appeared to have had the same materials in their composition. The best sun-dried bricks he met with are those which compose the ruin called Akerkout. In the kasr, or palace, our author found, in general, finer specimens of art; for, in addition to the substances generally strewed on the surfaces of all these mounds, he saw fragments of alabaster vessels, fine earthern-ware, marble, and great quantities of varnished tiles, *the glazing and colouring of which are surprisingly fresh.* The process from making pottery to moulding figures in clay, was not difficult; but the designs in brass, and the grouping of the figures, must have required much greater skill and labour.

RUINS OF PERSEPOLIS.

The most striking feature, on a first approach to these splendid ruins, is the stair-case and its surrounding walls.

Two grand flights, which face each other, lead to the principal platform. To their right is an immense wall of the finest masonry, and of the most massive stones; to the left, are other walls, equally well built, but not so imposing. On arriving at the summit of the stair-case, the first objects which present themselves directly facing the platform, are four vast portals and two columns. Two portals first, then the columns, and then two portals again. On the front of each are represented, in basso-relievo, figures of animals, which, for want of a better name, may be called sphinxes. The two sphinxes on the first portals face *outwardly, i. e.* towards the plain and the front of the building. The two others, on the second portals, face inwardly, *i. e.* towards the mountain. From the first, (to the right, on a straight line,) at the distance of fifty-four paces, is a stair-case of thirty steps, the sides of which are ornamented with bass-reliefs, originally in three rows, but now partly reduced by the accumulation of earth beneath, and by mutilations above. This stair-case leads to the principal compartment of the whole ruins, which may be called a small plain, thickly studded with columns, sixteen of which are now erect. Having crossed this plain, on an eminence are numerous stupendous remains of frames, both of windows and doors, formed by blocks of marble of sizes most magnificent. These frames are ranged in a square, and indicate an apartment the most royal that can be conceived. On each side of the frames are sculptured figures, and the marble still retains a polish which, in its original state, must have vied with the finest mirrors. On each corner of this room are pedestals, of an elevation much more considerable than the surrounding frames; one is formed of a single block of marble. The front of this apartment seems to have been to the south-west, for few marks of masonry are to be seen on that exposure, and the base of that side is richly sculptured and ornamented. This front opens upon a square platform, on which no building appears to have been raised. But on the side opposite to the room just mentioned, there is the same appearance of a corresponding apartment, although nothing but the bases of some small columns, and the square of its floor, attest it to have been such. The interval between these two rooms, (on those angles which are the furtherest distant from the grand front of the building,)

is filled up by the base of a sculpture, similar to the bases of the two rooms, excepting that the centre of it is occupied by a small flight of steps. Behind, and contiguous to these ruins, are the remains of another square room, surrounded on all sides by frames of doors and windows. On the floor are the bases of columns: from the order in which they appear to have stood, they formed six rows, each of six columns. A staircase, cut into an immense mass of rock, leads into the lesser and enclosed plain below. Towards the plain are also three smaller rooms, or rather one room and the bases of two closets. Every thing on this part of the building indicates rooms of rest or retirement.

In the rear of the whole of these remains, are the beds of aqueducts, which are cut into the solid rock. They occur in every part of the building, and are probably, therefore, as extensive in their course, as they are magnificent in their construction. The great aqueduct is to be discovered among a confused heap of stones, not far behind the buildings described above, on that quarter of the palace, and almost adjoining to a ruined stair-case. Its bed in some places is cut ten feet into the rock. This bed leads east and west; to the eastward its descent is rapid, about twenty-five paces; it there narrows; but again enlarges, so that a man of common height may stand upright in it. It terminates by an abrupt rock.

Proceeding from this towards the mountains, situated in the rear of the great hall of columns, stand the remains of a magnificent room. Here are still left walls, frames, and porticoes, the sides of which are thickly ornamented with bass-reliefs of a variety of compositions. This hall is a perfect square. To the right of this, and further to the southward, are more fragments, the walls and component parts apparently of another room. To the left of this, and therefore to the northward of the building, are the remains of a portal, on which are to be traced the features of a sphynx. Still towards the north, in a separate collection, is the ruin of a column, which, from the fragments about it, must have supported a sphynx. In a recess of the mountain, to the northward, is a portico. Almost in a line with the centre of the hall of columns, on the surface of the mountain, is a tomb. To the southward of that is another, in like manner on the mountain's surface; between both,

and just on that point where the ascent from the plain commences, is a reservoir of water.

These, observes Mr. Morier, in the account of his Embassy to Persia, constitute the sum of the principal objects among the ruins of Persepolis.

ROYAL PALACE OF ISPAHAN.

The palaces of the King are inclosed in a fort of lofty walls, which is estimated to have a circumference of three miles. The palace of the Chehel Sitoon, or 'forty pillars,' is situated in the middle of an immense square, which is intersected by various canals, and planted in different directions by the beautiful chenar tree. In front is an extensive square basin of water, from the fartherest extremity of which the palace is beautiful beyond either the power of language or the correctness of pencil to delineate. The first saloon is open towards the garden, and is supported by eighteen pillars, all inlaid with mirrors, and, the glass being in a much greater proportion than the wood, appears at a distance to be formed of glass only. Each pillar has a marble base, which is carved into the figures of four lions placed in such attitudes, that the shaft seems to rest on their four united backs. The walls, which form its termination behind, are also covered with mirrors placed in such a variety of symmetrical positions, that the mass of the structure appears to be of glass, and when new must have glittered with most magnificent splendour. The ceiling is painted in gold flowers, which are still fresh and brilliant. Large curtains are suspended on the outside, which are occasionally lowered to lessen the heat of the sun.

THE TEMPLE OF MECCA.

This magnificent temple, to which pilgrims resort from every quarter of the globe where the religion of Islamism is practised, is known by the Mussulmen under the name of El Haram, or the temple of excellence. It is situated nearly in the middle of the city, which is built in a valley, having a considerable slope from the north to the south. It is composed of the house of God, Beit Allah, or as it is called also, La Kaaba; of the Well of Zemzem, Bir Zemzem; of the Cobba, or place of Abraham, Makham, Ibrahim; of the places of the four orthodox rites, Makam

Hhaneffi, Makam Shaffi, Makam Maleki, and Makam Hhanbeli; of two Cobbas, or Chapels, El Cobbatain; of an arch, called Babes-selem (in the same style as a triumphal arch), near the place of Abraham; of El Monbar or the Tribune for the Priest; of the wooden staircase, Daureh, which leads to the saloon of the house of God; of an immense court, surrounded by a triple row of arches: of two smaller courts, surrounded with elegant piazzas; of nineteen doors; and of seven towers, or minarets, five of which adhere to the edifice, and the other two are placed between the neighbouring houses out of the inclosure.

La Kaaba, Beit Allah, or the house of God, is a quadrilateral tower, the sides and angles of which are unequal, so that its plan forms a true trapezium. The size of the edifice, and the black cloth which covers it, make this irregularity disappear, and give to it the figure of a perfect square.

The black stone, Hhajera el Assouad, or heavenly stone, which all true Mussulmen believe to have been brought thither by the angel Gabriel, is raised forty-two inches above the surface, and is bordered all round with a large plate of silver, about a foot broad. The part of the stone that is not covered by the silver at the angle is almost a semi-circle, six inches in height, by eight inches six lines diameter at its base.

El Bir Zemzem, or the well of Zemzem, is situated fifty-one feet distant to the E. 10° N. of the black stone. It is about seven feet eight inches in diameter, and fifty six feet deep to the surface of the water. The brim is of fine white marble, five feet high. Tradition records that this well was miraculously opened by the angel of the Lord for Agar, when she was nearly perishing from thirst in the desert with her son Ismael, after having been sent from Abraham's house.

The Kaaba, and the stones of Ismael, are situated nearly in the centre of the temple, and occupy the middle of an oval or irregular elliptical surface, which forms a zone of thirty-nine feet wide round the edifice, upon which the pilgrims make their tours round the Kaaba. It is paved with fine marble, and is situated upon the lowest plane of the temple.

HOLY LAND.

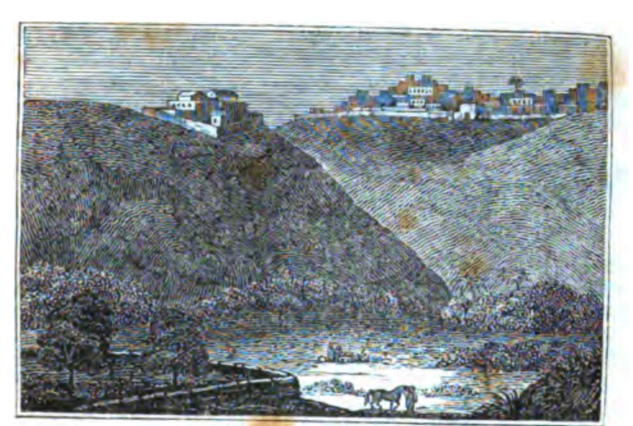
BETHLEHEM.

[*See Plate, No.* 66.]

BETHLEHEM is situated at the distance of six miles from JERUSALEM, in a fine country, blest with a salubrious air, and abundant fertility. The water is conveyed in a low aqueduct which formerly passed to Jerusalem. The FONS SIGNATUS is a charming spring, yielding a constant supply of water to three large cisterns, one of which is still in good preservation. At a small distance from these, a beautiful rivulet called the DELICIÆ SOLOMONIS laves the herbage of the valley, and fertilizes several fine gardens, while the circumjacent soil is richly clothed with an elegant assemblage of fig-trees, vines and olives.

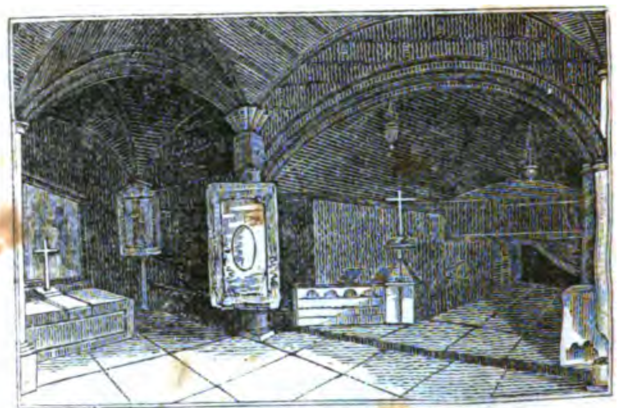
Bethlehem received its name, which signifies the *House of Bread*, from Abraham; and it was surnamed *Ephrata*, the Fruitful, after Caleb's wife, to distinguish it from another Bethlehem, in the tribe of Zebulon. It belonged to the tribe of Judah, and also went by the name of the City of David, that monarch having there been born, and tended sheep in his childhood. Abijan, the seventh judge of Israel, Elimelech, Obed, Jesse, and Boaz, were, like David, natives of Bethlehem, and here must be placed the scene of the admirable eclogue of Ruth. St. Matthias the apostle, also received life in the village of Bethlehem.

The convent is connected with the church by a court inclosed with lofty walls. This court leads by a small side-door into the church. The edifice is certainly of high antiquity, and, though often destroyed and as often repaired, it still retains marks of its Grecian origin. On the pavement at the foot of the altar you observe a marble star, which corresponds, as tradition asserts, with the point of the heavens where the miraculous star that conducted the three kings became stationary. The Greeks occupy the choir of the Magi, as well as the two other naves formed by the transform of the cross. These last are empty, and without altars. Two spiral staircases, each composed of fifteen steps, open on the sides of the outer church, and conduct to the subterraneous church situated beneath this choir. At the farther extremity of the crypt, on the east side, is the spot

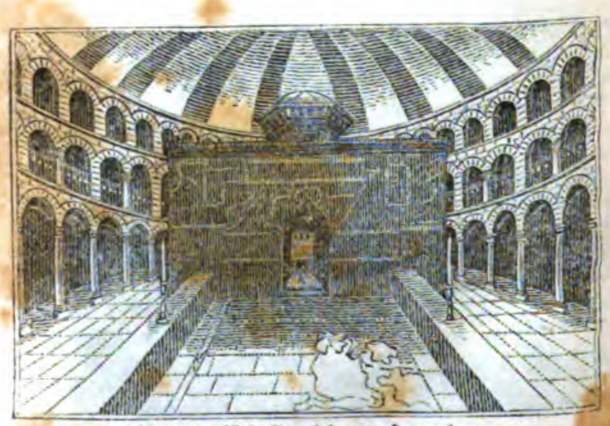


No. 66.—Bethlehem.

No. 67.—Nazareth.



No. 68.—Grotto of Nazareth.



No. 69.—Holy Sepulchre at Jerusalem.

where tradition reports the Virgin to have brought forth the Redeemer of Mankind. This spot is marked by a white marble, incrusted with jaspar, and surrounded by a circle of silver, having rays resembling those with which the sun is represented. Around it are inscribed these words:

HIC DE VIRGINE MARIA
JESUS CHRISTUS NATUS EST.

At the distance of seven paces towards the south, after you have passed the foot of one of the staircases leading to the upper church, you find the Manger. You go down to it by two steps, for it is not upon a level with the rest of the crypt. It is a low recess, hewn out of the rock. A block of white marble, raised about a foot above the floor, and hollowed in the form of a manger, indicates the spot where our Saviour was laid upon straw.

Two paces farther, opposite to the manger, stands an altar, which occupies the place where Mary sat when she presented the Child of Sorrow to the adoration of the Magi.

Nothing can be more pleasing, or better calculated to excite sentiments of devotion, than this subterraneous church. It is adorned with pictures of the Italian and Spanish schools. These pictures represent the mysteries of the place, the Virgin and Child, after Raphael, the Annunciation, the Adoration of the Wise Men, the Coming of the Shepherds, and all those miracles of mingled grandeur and innocence. The usual ornaments of the manger are of blue satin embroidered with silver. Incense is continually smoking before the cradle of the Saviour.

The Grotto of the Nativity leads to the subterraneous chapel, where tradition places the sepulchre of the Innocents: "Herod sent forth and slew all the children that were in Bethlehem, and in all the coasts thereof, from two years old and under. Then was fulfilled that which was spoken by Jeremiah the prophet, saying: In Rama was there a voice heard," &c.

NAZARETH.

[*See Plates, No.* 67, 68.]

The village of Nazareth is situated in a long valley, surrounded by lofty hills, between which a road leads to the neighbouring plain of Esdralon, and to Jerusalem. The convent is situated in the lower part of the village; and

the church belonging to it, a very handsome edifice, is erected over the grotto, or cave, in which, tradition says, the Virgin Mary took up her residence.

The other objects of veneration in Nazareth are, 1. The Work-shop of Joseph, which is near the convent, and was formerly included within its walls: this is now a small chapel, perfectly modern, and lately whitewashed. 2. The Synagogue, where Christ is said to have read the Scriptures to the Jews, at present a church. 3. A Precipice without the town, where, they say, the Messiah leaped down to escape the rage of the Jews, after the offence his speech in the synagogue had occasioned. Here they shew the impression of his hand, made as he sprang from the rock.

THE HOLY SEPULCHRE AT JERUSALEM.

[*See Plate, No.* 69.]

THE church of the Holy Sepulchre is very irregular, owing to the nature and situation of the places which it was designed to comprehend. It is nearly in the form of a cross. being one hundred and twenty paces in length, exclusive of the descent to the discovery of the Holy Cross, and seventy in breadth. It has three domes, of which that covering the Holy Sepulchre serves for the nave of the church. It is thirty feet in diameter, and is covered at top like the Rotunda at Rome. There is not any cupola, the roof being supported by large rafters, brought from Mount Lebanon.

On entering the church, you come to the Stone of Unction, on which the body of our Lord was anointed with myrrh and aloes, before it was laid in the sepulchre. Some say, that it is of the same rock as Mount Calvary; and others assert, that it was brought to this place by Joseph and Nicodemus, secret disciples of Jesus Christ, who performed this pious office, and that it is of a greenish colour. Be that as it may, on account of the indiscretion of certain pilgrims, who broke off pieces, it was found necessary to cover it with white marble, and to surround it with an iron railing, lest people should walk over it. This stone is eight feet, wanting three inches, in length, and two feet, wanting one inch, in breadth; and above it, eight lamps are kept continually burning.

The Holy Sepulchre is thirty paces from this stone, ex-

actly in the centre of the great dome; it resembles a small closet, hewn out of the solid rock. The entrance, which faces the east, is only four feet high, and two feet and a quarter broad. The interior of the sepulchre is nearly square. It is six feet, wanting an inch, in length, and six feet, wanting two inches, in breadth, and from the floor to the roof, eight feet one inch. There is a solid block of the same stone, which was left in excavating the other part: this is two feet four inches and a half high, and occupies half of the sepulchre, for it is six feet, wanting one inch, in length, and two feet and five-sixths wide. On this table the body of our Lord was laid, with the head towards the west, and the feet to the east; but, on account of the superstitious devotion of the Orientals, who imagine that, if they leave their hair upon this stone, God will never forsake them, and also, because the pilgrims broke off pieces, it has received a covering of white marble, on which mass is now celebrated. Forty-four lamps are constantly burning in this sacred place, and three holes have been made in the roof for the emission of the smoke. The exterior of the sepulchre is also faced with slabs of marble, and adorned with several columns, having a dome above.

The Holy Sepulchre is composed of three churches; that of the Holy Sepulchre, properly so called; that of Calvary; and the church of the Discovery of the Holy Cross. The first is built in the valley at the foot of Calvary, on the spot where tradition reports that the body of Christ was deposited. This church was in the form of a cross, the chapel of the Holy Sepulchre constituting, in fact, the nave of the edifice. It is circular, like the Pantheon at Rome, and is lighted only by a dome, beneath which is the sepulchre. Sixteen marble columns adorn the circumference of this rotunda: they are connected by seventeen arches, and support an upper gallery, likewise composed of sixteen columns and seventeen arches, of smaller dimensions than those of the lower range. Niches corresponding with the arches appear above the frieze of the second gallery, and the dome springs from the arch of these niches.

The origin of the church of the Holy Sepulchre is of high antiquity. The author of the Epitome of the Holy War asserts, that forty-six years after the destruction of Jerusalem by Vespasian and Titus, the Christians obtained

permission of Adrian to build, or rather to rebuild, a church over the tomb of their God, and to enclose, in the new city, the other places venerated by the Christians. This church, he adds, was enlarged and repaired by Helena, the mother of Constantine.

THE MOUNT OF OLIVES.

THE following descriptions of the spots in the Holy Land, which excite a more particular interest, are extracted from Dr. Clarke's very valuable Travels in Europe, Asia, and Africa.

"As we advanced, our journey led through an open campaign country, until, upon our right, the guides shewed us the Mount, where it is believed that Christ preached to his disciples that memorable sermon, concentrating the sum and substance of every Christian virtue. We left our route to visit this elevated spot; and, having attained the highest point of it, a view was presented, which, for its grandeur, independently of the interest excited by the different objects contained in it, has no parallel in the Holy Land.

"From this situation we perceived that the plain, over which we had been so long riding, was itself very elevated. Far beneath appeared other plains, one lower than the other, and extending to the surface of the sea of Tiberius, or Sea of Galilee. This immense lake, almost equal, in the grandeur of its appearance, to that of Geneva, spreads its waters over all the lower territory, extending from the north-east towards the south-west, and then bearing east of us. Its eastern shores present a sublime scene of mountains, extending towards the north and south, and seeming to close it in at either extremity, both towards Chorazin, where the Jordan enters, and the Aulon, or Campus-magnus, through which it flows to the Dead Sea. The cultivated plains reaching to its borders, which we beheld at an amazing depth below our view, resembled, by the various hues their different produce exhibited, the motley pattern of a vast carpet. To the north appeared snowy summits, towering, beyond a series of intervening mountains, with unspeakable greatness. We considered them as the summits of Libanus; but the Arabs belonging to our caravan called the principal eminence Jebel el Sieh, saying it was near Damascus; probably, therefore, a part of the chain of

Libanus. This summit was so lofty, that the snow entirely covered the upper part of it; not lying in patches, as I have seen it, during summer, upon the tops of very elevated mountains, (for instance, upon that of Ben Nevis, in Scotland,) but investing all the higher part with that perfect white and smooth velvet-like appearance which snow only exhibits when it is very deep; a striking spectacle in such a climate, where the beholder, seeking protection from a burning sun, almost considers the firmament to be on fire."

OTHER REVERED SITES.

"As we rode towards the Sea of Tiberius, the guides pointed to a sloping spot from the heights upon our right, whence we had descended, as the place where the miracle was accomplished by which our Saviour fed the multitude: it is therefore called *The Multiplication of Bread*; as the Mount above, where the Sermon was preached to his Disciples, is called *The Mountain of Beatitudes*, from the expressions used in the beginning of that discourse. The lake now continued in view upon our left. The wind rendered its surface rough, and called to mind the situation of our Saviour's Disciples, when, in one of the small vessels which traverse these waters, they were tossed in a storm, and saw Jesus in the fourth watch of the night, walking to them upon the waves. Often as this subject has been painted, combining a number of circumstances adapted for the representation of sublimity, no artist has been aware of the uncommon grandeur of the scenery, memorable on account of the transaction. The Lake of Gennesareth is surrounded by objects well calculated to heighten the solemn impression made by such a picture; and, independent of the local feelings likely to be excited in its contemplation, affords one of the most striking prospects in the Holy Land.

"Along the borders of this lake may still be seen the remains of those ancient tombs, hewn by the earliest inhabitants of Galilee, in the rocks which face the water. Similar works were before noticed among the Ruins of Telmessus. They were deserted in the time of our Saviour, and had become the resort of wretched men, afflicted by diseases, and made outcasts of society; for in the account of the cure performed by our Saviour upon a maniac in the coun-

try of the Gadarenes, these tombs are particularly alluded to; and their existence to this day, (although they have been neither noticed by priests nor pilgrims, and have escaped the ravages of the Empress Helena, who would undoubtedly, have shaped them into churches,) offers strong internal evidence of the accuracy of the Evangelist who has recorded the transaction: 'There met him *out of the tombs* a man with an unclean spirit, who had his dwelling *among the tombs*.'"

NAPOLOSE, OR SICHEM.

"There is nothing in the Holy Land finer than the view of this city from the surrounding heights. As the traveller descends towards it from the hills, it appears luxuriantly embosomed in the most delightful and fragrant bowers, half concealed by rich gardens, and by stately trees collected into groves, all around the bold and beautiful valley in which it stands. The traveller, directing his footsteps towards its ancient sepulchres, as everlasting as the rocks wherein they are hewn, is permitted, upon the authority of sacred and indelible record, to contemplate the spot where the remains of Joseph, of Eleazar, and of Joshua, were severally deposited.

"In the time of Alexander the Great, Sichem was considered as the capital of Samaria. Its inhabitants were called Samaritans, not merely as people of Samaria, but as a sect at variance with the other Jews. They consisted principally of deserters from Judæa. The principal object of veneration among them is Jacob's Well, over which a church was formerly erected. This is situated at a small distance from the town, in the road to Jerusalem, and has been visited by pilgrims of all ages; but particularly since the Christian æra, as the place where our Saviour revealed himself to the woman of Samaria.

MOSQUE OF OMAR.

Doctor Clarke, on viewing this Mosque, observes, that "the sight was so grand, that he did not hesitate in pronouncing it the most magnificent piece of architecture in the Turkish empire; and, considered externally, far superior to the mosque of St. Sophia in Constantinople. By the sides of the spacious area in which it stands, are certain

vaulted remains; these plainly denote the masonry of the ancients; and evidence may be adduced to prove, that they belonged to the foundations of Solomon's temple. He observed also that reticulated stucco, which is commonly considered as an evidence of Roman work. Phocas believed the whole space surrounding this building to be the ancient area of the temple; and Golius, in his notes upon the Astronomy of Alferganes, says, the whole foundation of the original edifice remained. As to the mosque itself, there is no building at Jerusalem that can be compared with it, either in beauty or riches.† The lofty Saracenic pomp so nobly displayed in the style of the building; its numerous arcades; its capacious dome, with all the stately decorations of the place; its extensive area, paved and variegated with the choicest marbles; the extreme neatness observed in every avenue towards it; and, lastly, the sumptuous costume observable in the dresses of all the Eastern devotees, passing to and from the sanctuary, make it altogether one of the finest sights the Mahometans have to boast."

MOSQUE OF ST. SOPHIA AT CONSTANTINOPLE.

The dome of this celebrated structure is one hundred and thirteen feet in diameter, and is built on arches, sustained by vast pillars of marble. The pavement and staircase are also of marble. There are two rows of galleries supported by pillars of party-coloured marble, and the entire roof is of fine mosaic work. In this mosque is the superb tomb of the Emperor Constantine, for which the Turks have the highest veneration.

Beside the above, two other mosques attract the particular notice of travellers who visit the Turkish capital. That of the Valide-Sultan, founded by the mother of Mahomed IV, is the largest, and is built entirely of marble. Its proportions are stupendous; and it boasts the finest symmetry. The mosque of Sultan Solyman is an exact square, with four fine towers in the angles: in the centre is a noble cupola, supported by beautiful marble pillars. Two smaller ones at the extremities are supported in the same manner. The pavement and gallery surrounding the mosque are of marble; and under the great cupola is a fountain, adorned with such finely-coloured pillars, that they can scarcely be deemed of

natural marble. On one side is the pulpit, of white marble; and on the other the little gallery for the grand Signior.—A fine staircase leads to it; and it is built up with gilt lattices. At the upper end is a kind of altar, on which the name of God is inscribed: and before it stand two candlesticks, six feet in height, with wax candles in proportion. The pavement is spread with fine carpets, and the mosque illuminated by a vast number of lamps. The court leading to it is very spacious, with galleries of marble, supported by green columns, and covered by 28 leaden cupolas on the sides, with a fine fountain in the centre.

The mosque of Sultan Selim I. at Adrianople is another surprising monument of Turkish architecture. It is situated in the centre and most elevated part of the city, so as to make a very noble display. The first court has four gates, and the innermost three; both being surrounded by cloisters, with marble pillars of the Ionic order, finely polished, and of very lively colours: the entire pavement is of white marble, and the roof of the cloisters is divided into several cupolas or domes, surmounted with gilt balls. In the midst of each court are fine fountains of white marble; and, before the grand entrance, is a portico, with green marble pillars, provided with five gates. The body of the mosque is one prodigious dome, adorned with lofty towers, whence the *imaums*, or priests, call the people to prayers. The ascent to these towers are very artfully contrived: there is but one door, which leads to three different staircases, going to three different stories of the tower, in such a manner, that three priests may ascend and descend, by a spiral progress, without meeting each other.

The walls of the interior are inlaid with porcelain, ornamented with small flowers and other natural objects, in very lively colours. In the centre hangs a vast lamp of gilt silver, besides which there are at least two thousand smaller ones: the whole, when lighted, have a very splendid effect.

RUINS OF CARTHAGE.

The remains of the grandeur and magnificence of Carthage, the rival of Rome, and one of the most commercial cities of the ancient world, are not so striking as might be expected; and, at a little distance, can scarcely be distinguished from the ground on which they lie. The vestiges of

triumphal arches, of superb specimens of Grecian architecture, of columns of porphyry or granite, or of curious entablatures, are no longer discernible: all are vanished; and thus it will be in future ages with the most renowned cities now on earth!

To discover these ruins requires some method. Leaving Tunis, the traveller rides along the shore in an east-north-east direction, and reaches, in about half an hour, the salt-pits which extend toward the west, as far as a fragment of wall, very near to the Great Reservoirs. Passing between these salt pits and the sea, jetties are seen running out to a considerable distance under water. The sea and the jetties are on his right; on his left he perceives a great quantity of ruins, upon eminences of unequal height; and below these ruins a basin of a circular form, and of considerable depth, which formerly communicated with the sea by means of a canal, traces of which are still to be seen. This basin appears to have been the Cothon, or inner port of Carthage. The remains of the immense works discernible in the sea, in this case indicate the site of the outer mole. Some piles of the dam said to have been constructed by Scipio, for the purpose of blocking up the port, may be still distinguished. A second inner canal is conjectured to have been the cut made by the Carthaginians, when they opened a new passage for their fleet.

The greater part of Carthage was built on three hills. On a spot which overlooks the eastern shore is the area of a spacious room, with several smaller ones adjoining: some of them have tesselated pavements; and in all are found broken pieces of columns of fine marble and porphyry. They are conjectured to have been summer apartments beneath one of the palaces, such as the intense heat of the climate must have required.

In rowing along the shore, the common sewers are still visible, and but little impaired by time. With the exception of these, the cisterns have suffered the least. Besides such as belong to private houses, there are two sets for the public use of the Tunisians: the largest of these was the grand reservoir, and received the water of the aqueduct. It lay near the western wall of the city, and consisted of upwards of twenty contigious cisterns, each about one hundred feet in length, and thirty in breadth. They form

a series of vaults, communicating with each other, and are bordered throughout their whole length by a corridor. The smaller reservoir has a greater elevation, and lies near the Cothon or inner port.

The ruins of the noble aqueduct which conveyed the water into the larger cisterns, may be traced as far as Zawan and Zungar, at least fifty miles distant. This must have been a truly magnificent, and at the same time, a very expensive work. That part of it which extends along the peninsula was beautifully faced with stone. At Arriana, a village to the north of Tunis, are several entire arches 70 feet high, and supported by piers 16 feet square. The water-channel is vaulted over, and plastered with a strong cement. A person of an ordinary height may walk upright in it; and at intervals are apertures, left open, as well for the admission of fresh air, as for the convenience of cleansing it. The water-mark is nearly three feet high; but it is impossible to determine the quantity daily conveyed to Carthage by this channel, without knowing the angle of descent, which, in its present imperfect state, cannot be ascertained.

Temples were erected at Zawan and Zungar, over the fountains by which this aqueduct was supplied. That at Zungar appears to have been of the Corinthian order, and terminates very beautifully in a dome with three niches, probably intended for the statues of the divinities of the spring.

THE PLAIN OF TROY.

According to Homer's description of the Trojan territory, it combined certain prominent and remarkable features, not likely to be affected by any lapse of time. Of this nature was the Hellespont; the Island of Tenedos; the Plain itself; the river by whose inundations it was occasionally overflowed; and the mountain whence that river issued. The following is an abstract of Dr. Clarke's accurate account of the vestiges of high antiquity contained in this truly classic spot.

"We entered an immense plain, in which some Turks were engaged hunting wild-boars. Peasants were also employed in ploughing a deep and rich soil of vegetable earth. Proceeding towards the east, and round the bay distinctly pointed out by Strabo, as the harbour in which the Grecian fleet was stationed, we arrived at the Sepulchre of Ajax, upon the ancient Rhœtean Promontory. The view

here afforded of the Hellespont and the Plain of Troy is one of the finest the country affords.

"From the *Aianteum* we passed over a heathy country to *Halil Elly*, a village near the Thymbrius, in whose vicinity we had been instructed to seek the remains of a temple once sacred to the Thymbrean Apollo. The ruins we found were rather the remains of ten temples than of one. The earth to a very considerable extent was covered by subverted and broken columns of marble, granite, and of every order in architecture. Doric, Ionic, and Corinthian capitals, lay dispersed in all directions, and some of these were of great beauty. We observed a bass-relief representing a person on horseback pursued by a winged figure: also a beautiful representation, sculptured after the same manner, of Ceres in her car drawn by two scaly serpents.

At the town or village of Tchiblack, we noticed very considerable remains of ancient sculpture, but in such a state of disorder and ruin, that no precise description of them can be given. The most remarkable are upon the top of a hill called *Beyan Mezaley*, near the town, in the midst of a beautiful grove of oak trees, towards the village of Callifat. Here the ruins of a Doric temple of white marble lay heaped in the most striking manner, mixed with broken stelæ, cippi, sarcophagi, cornices and capitals of very enormous size, entablatures, and pillars. All of these have reference to some peculiar sanctity by which this hill was anciently characterized.

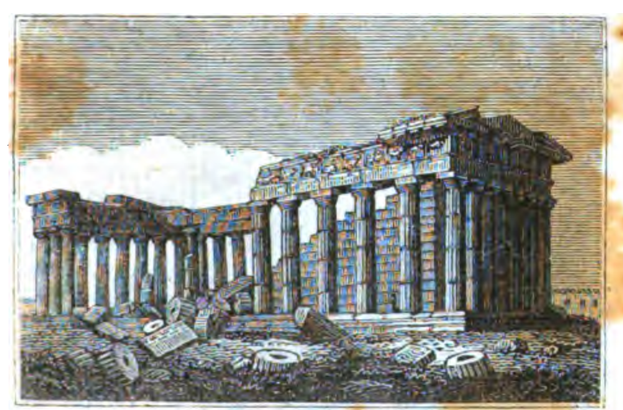
"We proceeded hence towards the plain; and no sooner reached it, than a tumulus of very remarkable size and situation drew our attention, for a short time, from the main object of our pursuit. This tumulus, of a high conical form and very regular structure, stands altogether insulated. Of its great antiquity no doubt can be entertained by persons accustomed to view the everlasting sepulchres of the ancients. On the southern side of its base is a long natural mound of lime-stone: this, beginning to rise close to the artificial tumulus, extends towards the village of Callifat, in a direction nearly from north to south across the middle of the plain. It is of such height that an army encamped on the eastern side of it, would be concealed from all observation of persons stationed on the coast, by

the mouth of the Mender. If the Poems of Homer, with reference to the Plain of Troy, have similarly associated an artificial tumulus and a natural mound, a conclusion seems warranted, that these are the objects to which he alludes. This appears to be the case in the account he has given of the *Tomb of Ilus* and the *Mound of the Plain.*

"From this tomb we descended into the plain, when our guides brought us to the western side of it, near its southern termination, to notice a tumulus, less considerable than the last described, about three hundred paces from the mound, almost concealed from observation by being continually overflowed, upon whose top two small oak trees were then growing.

"We now came to an elevated spot of ground, surrounded on all sides by a level plain, watered by the Callifat Osmack, and which there is every reason to believe the *Simoisian.* Here we found, not only the traces, but also the remains of an ancient citadel. Turks were then employed raising enormous blocks of marble, from foundations surrounding the place; possibly the identical works constructed by Lysimachus, who fenced New Ilium with a wall. All the territory within these foundations was covered by broken pottery, whose fragments were parts of those ancient vases now held in such high estimation. Many Greek medals had been discovered in consequence of the recent excavations made there by the Turks. As these medals, bearing indisputible legends to designate the people by whom they were fabricated, have also, in the circumstances of their discovery, a peculiar connection with the ruins here, they may be considered as indicating, with tolerable certainty, the situation of the city to which they belonged. These ruins evidently appear to be the remains of *New Ilium;* whether we regard the testimony afforded by their situation, as accordant with the text of Strabo, or the discovery there made of medals of the city."

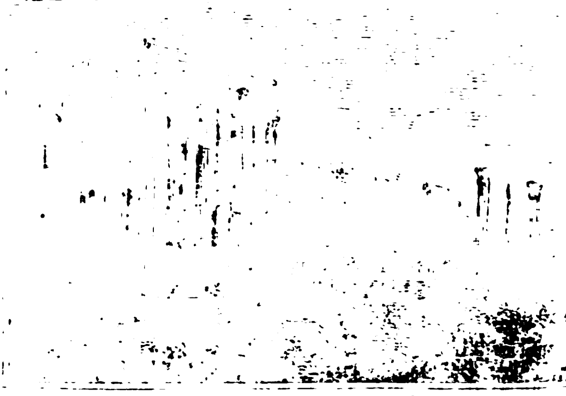
The conclusions relative to Troas, drawn by this learned writer, are as follows:—"That the river Mender is the Scamander of Homer, Strabo, and Pliny. The *amnis navigabilis* of Pliny flows into the Archipelago, to the south of Sigeum. That the Aianteum, or *Tomb of Ajax,* still remains, answering the description given of its situation by ancient authors, and thereby determining also the exact



No. 70.—Parthenon at Athens.



No. 71.—Temple of Jupiter.



position of the naval station of the Greeks. • That the Thymbrius is yet recognised, both in its present appellation *Thymbreck*, and in its geographical position. That the spacious plain lying on the north-eastern side of the Mender, and watered by the *Callifat Osmack*, is the Simoisian, and that stream the Simois. That the ruins of *Palaio Callifat* are those of the Ilium of Strabo. Eastward is the *Throsmos*, or Mound of the Plain. That *Udjek Tepe* is the tomb of Æsyetes. The other tombs mentioned by Strabo, as at Sigeum, are all in the situation he describes. That the springs of Bonarbashy may possibly have been the ΔΟΙΑΙ ΠΗΛΑΙ of Homer; but they are not sources of the Scamander. They are, moreover, *warm* springs. That the source of the Scamander is in Gargarus, now called *Kasdaghy*, the highest mountain of all the Idæan Chain. That the Altars of Jupiter, mentioned by Homer, and by Æschylus, were on the hill called *Kuchunlu Tepe*, at the foot of Gargarus; where the ruins of the Temple now remain. That *Palae Scepsis* is yet recognised in the appellation *Esky Skupshu*; that *Æna* is the *Ainei* of Strabo; and *Æne Tepe*, perhaps, the *Tomb of Æneas*. That the extremity of the Adramyttian Gulph inclines round the ridge of Gargarus, towards the north-east; so that the circumstance of Xerxes having this mountain upon his left, in his march from Antandrus to Abydus, is thereby explained. And lastly, that Gargarus affords a view, not only of all the Plain of Troy, but of all the district of Troas, and a very considerable portion of the rest of Asia Minor."

ATHENS.

[*See Plates, No.* 70, 71.]

THE approach to this celebrated city by sea, presents a spectacle, which was viewed by Dr. Clarke and his companions with great transports of joy. It was no sooner descried, than its lofty edifices, catching the sun's rays, rendered the buildings in the Acropolis visible at the distance of fifteen miles.

"The reflected light gave them a white appearance. The PARTHENON appeared first, above a long chain of hills in the front; presently we saw the top of Mount Anchesmus, to the left of the temple; the whole being backed by a lofty mountainous ridge, which we supposed to be Parnes.

"As we drew near to the walls, we beheld the vast Cecropian Citadel, crowned with temples that originated in the veneration once paid to the memory of the illustrious dead, surrounded by objects telling the same theme of sepulchral grandeur, and now monuments of departed greatness, gradually mouldering in all the solemnity of ruin. So paramount is this funeral character in the approach to Athens from the Piræus, that, as we passed the hill of the Museum, which was, in fact, an ancient cemetery of the Athenians, we might have imagined ourselves to be among the tombs of Telmessus, from the number of the sepulchres hewn in the rock, and from the antiquity of the workmanship, evidently not of later date than any thing of the kind in Asia Minor. In other respects the city exhibits nearly the appearance so briefly described by Strabo eighteen centuries before our coming; and, perhaps, it wears a more magnificent aspect, owing to the splendid remains of Hadrian's Temple of Olympian Jove, which did not exist when Athens was visited by the Disciple of Xenarchus. The prodigious columns belonging to this temple appeared full in view between the Citadel and the bed of the Ilissus: high upon our left rose the Acropolis, in the most impressive grandeur: an advanced part of the rock upon the western side of it is the Hill of the Areopagus, where St. Paul preached to the Athenians, and where their most solemn tribunal was held. Beyond all, appeared the beautiful Plain of Athens, bounded by Mount Hymettus. We rode towards the craggy rock of the Citadel, passing some tiers of circular arches at the foot of it; these are the remains of the Odeum of Herodes Atticus, built in memory of his wife Regilla. Thence continuing to skirt the base of the Acropolis, the road winding rather towards the north, we saw also, upon our left, scooped in the solid rock, the circular sweep on which the Athenians were wont to assemble to hear the plays of Æschylus, and where the Theatre of Bacchus was afterwards constructed.

"We proceeded towards the east, to ascend Mount Anchesmus, and to enjoy in one panoramic survey the glorious prospect presented from its summit, of all the antiquities and natural beauties in the Athenian Plain.—We ascended to the commanding eminence of the Mount, once occupied by a Temple of Anchesmian Jupiter. The Pa-

gan Shrine, has, as usual, been succeeded by a small Christian Sanctuary: it is dedicated to St. George. Of the view from this rock, even Wheeler could not write without emotion. 'Here,' said he 'a *Democritus* might sit and laugh at the pomps and vanities of the world, whose glories so soon vanish; or an *Heraclitus* weep over its manifold misfortunes, telling sad stories of the various changes and events of Fate.' The prospect embraces every object, excepting only those upon the south-west side of the Castle. The situation of the observer is north-east of the City; and the reader may suppose him to be looking, in a contrary direction, towards the ACROPOLIS, which is in the centre of this fine picture; thence regarding the whole circuit of the Citadel, from its north-western side, toward the south and east, the different parts of it occur in the following order, although to a spectator they all appear to be comprehended in one view.

"The lofty rocks of the ACROPOLIS, crowned with its majestic temples, the PARTHEON ERECTHEUM, &c. constitute the central object. In the foreground is displayed the whole of the modern city of Athens, with its gardens, ruins, mosques, and walls, spreading into the plain beneath the Citadel. On the right, or north-west wing, is the TEMPLE OF THESEUS; and on the left, or south-west wing, the TEMPLE OF JUPITER OLYMPUS. Proceeding from the west to the south and east, the view beyond the Citadel displays THE AREOPAGUS, THE PNYX, ILISSUS, the site of THE TEMPLE OF CERES IN AGRÆ, THE FOUNTAIN CALLIRHOE, THE STADIUM PANTHENAIUM, the site of THE LYCEUM, &c. In a parallel circuit, with a more extended radius, are seen the hills and defile of DAPHNE, or VIA SACRA, THE PIRÆEUS, MUNYCHIA and PHALERUM, SALMAIS, ÆGINA, the more distant Isles, and HYMETTUS. A similar circuit, but still more extended, embraces PARNES, the Mountains beyond ELUSIS and MEGARA, THE ACROPOLIS OF CORINTH, the Peloponnessian Mountains, and the Ægean and distant Islands. And lastly, immediately beneath the eye, lies THE PLAIN OF ATHENS."

TEMPLES OF ELEPHANTA.

THE Island of Elephanta, distant about two leagues from Bombay, has a circumference of about three miles, and

consists of two rocky mountains, covered with trees and brushwood. Near the landing-place is the figure of an elephant, as large as life, shaped out of a rock, and supposed to have given its name to the island. Having ascended the mountain by a narrow path, the visitor reaches the excavation which has so long excited the attention of the curious, and afforded such ample scope for the discussion of antiquarians. With the strongest emotions of surprise and admiration, he beholds four rows of massive columns cut out of the solid rock, uniform in their order, and placed at regular distances, so as to form three magnificent avenues from the principal entrance to the grand idol which terminates the middle vista; the general effect being heightened by the blueness of the light, or rather gloom, peculiar to the situation. The central image is composed of three colossal heads, reaching nearly from the floor to the roof, a height of fifteen feet. It represents the triad deity in the Hindoo mythology, BRAHMA, VISHNOO, and SEEVA, in the characters of the creator, preserver, and destroyer. The middle face displays regular features, and a mild and serene character; the towering head-dress is much ornamented, as are those on each side, which appear in profile, lofty, and richly adorned with jewels. The countenance of Vishnoo has the same mild aspect as that of Brahma; but the visage of Seeva is very different,—severity and revenge, characteristic of his destroying attribute, are strongly depicted; one of the hands embraces a large COBRA DE CAPELLO; while the others contain fruit, flowers, and blessings for mankind, among which the lotos and pomegranate are readily distinguishable. The former of these, the lotus, so often introduced into the Hindoo mythology, forms a principal object in the sculpture and paintings of their temples, is the ornament of their sacred lakes, and the most conspicuous beauty in their flowery sacrifices.

On either side of the Elephanta triad is a gigantic figure leaning on a dwarf, an object frequently introduced in these excavations. The giants guard the triple deity, and separate it from a large recess filled with a variety of figures, male and female, in different attitudes; they are in tolerable proportion, but do not express any particular character of countenance: one conspicuous female, like the Amazons, is single breasted; the rest, whether intended for



No. 28.—Mausoleum of Hyder Aly.

No. 29.—Banian Tree.

goddesses or mortals, are generally adorned, like the modern Hindoo women, with bracelets and rings for the ankles; the men have bracelets only. The intervening space between these figures is occupied by small aerial beings, hovering about them in infinite variety. The larger images in these groups are in alto-relievo, and most of the smaller in basso-relievo, brought sufficiently forward from the rock to produce a good effect.

The sides of the temple are adorned with similar compositions, placed at regular distances, and terminating the avenues formed by the colonnades, so that only one group is seen at a time, except on a near approach; the regularity and proportion of the whole are remarkably striking. The figures are in general in graceful attitudes; but those of Herculanean statue do not indicate any extraordinary muscular strength. Among many thousands of them, few of the countenances express any particular passion, or mark a decided character; they have generally a sleepy aspect, and bear a greater resemblance to the tame sculpture of Egypt than to the animated works of the Grecian chisel.

From the right and left avenues of the principal temple are passages to smaller excavations on each side: that on the right is much decayed, and very little of the sculpture remains entire. A pool of water penetrates from it into a dark cavern far under the rock; but whether natural or artificial, has not been decided. A small corresponding temple on the left side, contains two baths, one of them elegantly finished; the front is open, and the roof supported by pillars of a different order from those in the large temple; the sides are adorned with sculpture, and the roof and cornice painted in mosaic patterns; some of the colours are still bright. The opposite bath, of the same proportions, is less ornamented; and between them is a room detached from the rock, containing a colossal representation of the *Lingam*, or symbol of Seeva. Several small caves branch out from the grand excavations.

An anecdote is related by Mr. Forbes, in his Oriental Memoirs, relative to these sculptured monuments. He accompanied an eminent English Artist on his first visit to the Elephanta. "After the glare of a tropical sun, during the walk from the landing place, it was some time before the eye had accommodated itself to the gloom of these sub

terraneous chambers, sufficiently to discriminate objects in that sombre light. We remained for several minutes without speaking, or looking particularly at each other: at length, when more familiarized to the cavern, my companion still remaining silent, I expressed some fear of having been too warm in my description, and that like most other objects, the reality fell short of the anticipated pleasure. He soon relieved my anxiety by declaring, that however highly he had raised his imagination, he was so absorbed in astonishment and delight, on entering this stupendous scene, as to forget where he was. He had seen the most striking objects of art in Italy and Greece; but never any thing which filled his mind with such extraordinary sensations." So enraptured was this artist with the spot, that after staying until a late hour, he quitted it most reluctantly.

The caves of the Isle of Elephanta cannot be sufficiently admired, when the immensity of such an undertaking, the number of artificers employed, and the extraordinary genius of its projector, are considered, in a country until lately accounted rude and barbarous by the now enlightened nations of Europe. Had this work been raised from a foundation, like other structures, it would have excited the admiration of the curious; but when the reflection is made, that it is hewn inch by inch in the hard and solid rock, how great must the astonishment be at the conception and completion of the enterprize!

TEMPLES OF SALSETTE.

High over-head, sublime,
The mighty gate-way's storied roof was spread,
Dwarfing the puny piles of younger time.
With the deeds of days of yore,
The ample roof was sculptured o'er,
And many a god-like form there met the eye,
And many an emblem dark of mystery.
Such was the city, whose superb abodes
Seem'd scoop'd by giants for the immortal gods.
Now all is silence dread,
Silence profound and dead,
The everlasting stillness of the deep!

SOUTHEY.

THE excavations of the Island of Salsette, also contigious to Bombay, are hewn in the central mountains. The great temple is excavated at some distance from the summit of a

steep mountain, in a commanding situation. This stupendous work is upwards of ninety feet long, thirty-eight wide, and of a proportionate height, hewn out of the solid rock, and forming an oblong square, with a fluted concave roof. The area is divided into three aisles by regular colonnades, similar to the ancient basilic, a pile of building twice as long as it was wide, and one of the extremities of which terminated in a hemicycle, two rows of columns forming a spacious area in the centre, and leaving a narrow walk between the columns and the wall. In these *basilici* the Roman emperors of the east frequently administered justice. This magnificent excavation at Salsette appears to be on the same plan, although, doubtless, intended for a place of worship: towards the termination of the temple, fronting the entrance, is a circular pile of solid rock, nineteen feet high, and forty-eight in circumference, most probably a representation of the lingam, the symbol already alluded to in the description of the temples of Elephanta. In this temple there are not any images, nor any kind of sculpture, except on the capitals of the pillars, which are in general finished in a very masterly style, and are little impaired by time. Several have been left in an unfinished state; and on the summit of others is something like a bell, between elephants, horses, lions, and animals of different kinds.

The lofty pillars and concave roof of the principal temple at Salsette present a much grander appearance than the largest excavation at the Elephanta, although that is much richer in statues and bass-reliefs. The portico at Salsette, of the same height and breadth as the temple, is richly decorated: on each side a large niche contains a colossal statue, well executed; and facing the entrance are small single figures, with groups in various attitudes, all of them in good preservation. The outer front of the portico, and the area before it, corresponding in grandeur with the interior, are now injured by time, and the mouldering sculpture intermingled with a variety of rock-plants. On the square pillars at the entrance are long inscriptions, the characters of which are obsolete, and which modern ingenuity has not as yet succeeded in decyphering.

Farther up the mountain, a flight of steps, hewn in the rock, and continued to the summit, leads, by various intricate paths, to smaller excavations, most of which consist

of two rooms, a portico and benches, cut in the rock. To each is annexed a cistern of about three cubic feet, also hewn in the rock, for the preservation of rain-water. Some of these excavations are larger and better finished than others; and a few, although inferior in size and decoration, in their general effect resemble the principal temple.

The whole appearance of this excavated mountain indicates it to have had a city hewn in its rocky sides, capable of containing many thousand inhabitants. The largest temple was, doubtless, their principal place of worship; and the smaller, on the same plan, inferior ones. The rest were appropriated as dwellings for the inhabitants, differing in size and accommodation according to their respective ranks in society; or, as it is still more probable, these habitations were the abode of religious brahmins, and of their pupils, when India was the nursery of art and science, and the nations of Europe were involved in ignorance and barbarism.

MAUSOLEUM OF HYDER ALLY.

[*See Plate, No.* 28.]

This splendid monument of oriental grandeur is situated at the western extremity of the great garden of Seringapatam, a city of Hindostan, and capital of the Mysore territory. It is surrounded by a grove of beautiful cypress-trees, and was erected by Tippoo Saib in honour of the deceased sovereign, his father. Beneath tombs of black marble, elevated about eighteen inches from the ground, lie the bodies of Hyder Ally, his consort, and Tippoo Saib. They are covered with rich cloths, and have canopies over them. The whole of this sumptuous edifice is, together with its dome, supported by brilliantly-polished black marble columns. It is surrounded by a magnificent area, within which the fakirs have cells allotted to them; and on an elevated platform are the tombs of several faithful servants. The mosque annexed to it is flanked by two towers. The Moulahs stationed there are, through the liberality of the British government, still allowed two thousand pagodas per annum to read the Koran; and three pagodas are daily distributed in charity at the mausoleum.



No. 42.—Great Wall of China.



No. 43.—Natural Road under the Mountain of Filifeld.

THE TAJE MAHAL.

This grand mausoleum, which stands due north and south, on the southern bank of the river Jumna, was built by command of the Emperor Shah Jehan for the interment of his favourite sultana *Momtaz mehl*, or *Montazal Zumani*, the "*Pre-eminent in the seraglio*, or, *Paragon of the age*," and at his death his remains were also here deposited, by order of his son Aurungzebe.

This building, in point of design and execution, is one of the most extensive, elegant, commodious, and perfect works ever undertaken and finished by one man. To this celebrated architect the Emperor Shah Jehan gave the title of *Zerreer dust*, or, *Jewel-handed*, to distinguish him from all other artists.

It is built entirely of pure white marble, on an immense square platform of the same material, having a lofty minaret of equal beauty at every corner. On each side and behind the imperial mausoleum, is a suite of elegant apartments, also of white marble, highly decorated with coloured stones. The tombs and other principal parts of this vast fabric are inlaid with wreaths of flowers and foilage in their natural colours, entirely composed of cornelians, onyxes, verd-antique, lapis-lazuli, and a variety of agates, so admirably finished as to have rather the appearance of an ivory model set with jewels.

It was commenced in the fifth year of the reign of the Emperor Shah Jehan, and the whole completed in sixteen years, four months, and twenty-one days. It cost ninety-eight lacks, or nine millions eight hundred and fifteen thousand rupees, equal to one million two hundred and twenty-five thousand pounds sterling: although the price of labour then was, and still continues to be very reasonable in India.

GREAT WALL OF CHINA.

[*See Plate, No.* 42.]

This stupendous wall, which extends across the northern boundary of the Chinese Empire, is deservedly ranked among the grandest labours of art. It is conducted over the summits of high mountains, several of which have an elevation of not less than 5225 feet, (nearly a mile) across

deep vallies and over wide rivers, by means of arches: in many parts it is doubled or trebled, to command important passes; and at the distance of nearly every hundred yards is a tower or massive bastion. Its extent is computed at 1500 miles; but in some parts, where less danger is apprehended, it is not equally strong or complete, and towards the N. W. consists merely of a strong rampart of earth.—Near Koopekoo it is twenty-five feet in height, and the top about fifteen feet thick: some of the towers, which are square, are forty-eight feet high, and about forty feet in width. The stone employed in the foundations, angles, &c. is a strong grey granite; but the materials for the greater part consist of bluish bricks, and the mortar is remarkably pure and white.

The area of the construction of this great barrier, which has been and will continue to be the wonder and admiration of ages, is considered by Sir George Staunton as having been absolutely ascertained; and he asserts that it has existed for two thousand years. In this assertion he appears to have followed Du Halde, who informs us that "this prodigious work was constructed two hundred and fifteen years before the birth of Christ, by order of the first Emperor of the family of Tsin, to protect three large provinces from the irruptions of the Tartars." However, in the History of China, contained in his first volume, he ascribes this erection to the second Emperor of the dynasty of Tsin, named Chi Hoang Ti; and the date immediately preceding the narrative of this construction is the year 137 before the birth of Christ. Hence suspicions may arise, not only concerning the epoch when this work was undertaken, but also relatively to the purity and precision of the Chinese annals in general. Mr. Bell, who resided some time in China, and whose travels are deservedly esteemed for the accuracy of their information, assures us that this wall was built somewhere about the year 1160, by one of the Emperors, to prevent the frequent incursions of the Mongùls, whose numerous cavalry used to ravage the provinces, and effect their escape before an army could be assembled to oppose them. Renaudot observes that this wall is not mentioned by any oriental geographer whose writings boast a higher antiquity than three hundred years; and it is surprising that it should have escaped Marco Paulo, who, admitting that he entered

China by a different route, can hardly be supposed, during his long residence in the north of China, and in the country of the Monguls, to have remained ignorant of so stupendous a work. Amid these difficulties, it may be reasonably conjectured, that similar modes of defence had been adopted in different ages; and that the ancient rude barrier, having fallen into decay, was replaced, perhaps after the invasion of Singis, by the present erection, which, even from its state of preservation, can scarcely aspire to a very remote antiquity.

PORCELAIN TOWER AT NANKIN.

This elegant and commodious building, a very correct idea of which may be formed from the cut, may be regarded as a fine specimen of oriental pagodas. The tower is about two hundred feet in height, and derives its name from its having a chain or porcelain coating. The Portuguese were the first to bestow on these superb edifices the title of pagodas, and to attribute them to devotional purposes.—There can be little doubt, however, that in many instances they have been rather erected as public memorials or ornaments, like the columns of the Greeks and Romans.

Mr. Ellis in his Journal of the late Embassy to China, relates that, in the company of three gentlemen of the Embassy, he succeeded in passing completely through the uninhabited part of the city of Nankin, and in reaching the gateway visible from the Lion Hill. The object of the party was to have penetrated through the streets to the Porcelain Tower, apparently distant two miles. To this, however, the soldiers who accompanied them, and who from their willingness in allowing them to proceed thus far, were entitled to consideration, made so many objections, that they were forced to desist, and to content themselves with proceeding to a temple on a neighbouring hill, from which they had a complete view of the city. From this station the Porcelain Tower presented itself as a most magnificent object.

THE SHOEMADOO AT PEGU.

[*See Plate, No.* 72.]

The object in Pegu that most attracts and most merits notice, says Mr. Symes in his Embassy to Ava, is the

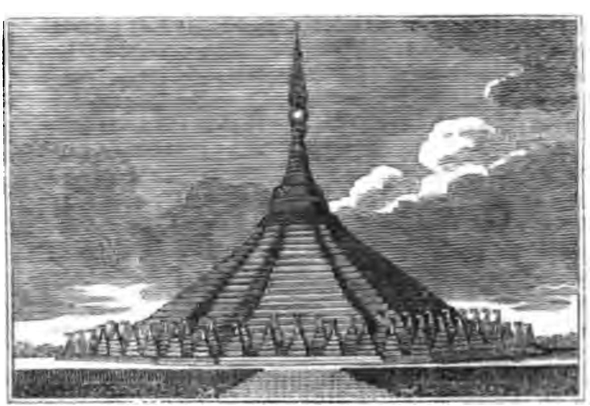
noble edifice of Shoemadoo, or the Golden Supreme.—This extraordinary pile of buildings is erected on a double terrace, one raised upon another. The lower and greater terrace is about ten feet above the natural level of the ground, forming an exact parallelogram: the upper and lesser terrace is similar in shape, and rises about twenty feet above the lower terrace or thirty above the level of the country. I judged a side of the lower terrace to be 1391 feet; of the upper 684. The walls that sustained the sides of the terrace, both upper and lower, are in a ruinous state; they were formerly covered with plaster, wrought into various figures; the area of the lower is strewed with the fragments of small decayed buildings, but the upper is kept free from filth, and is in tolerable good order. There is reason to conclude that this building and the fortress are coeval, as the earth of which the terraces are composed appears to have been taken from the ditch; there being no other excavation in the city, or in its neighbourhood, that could have afforded a tenth part of the quantity.

The terraces are ascended by flights of stone steps, which are now broken and neglected. On each side are dwellings of the Rhahaans, raised on timbers four or five feet from the ground; these houses consist only of a large hall: the wooden pillars that support them are turned with neatness; the roofs are covered with tiles, and the sides are made of boards; and there are a number of bare benches in every house, on which the Rhahaans sleep; but we saw no other furniture.

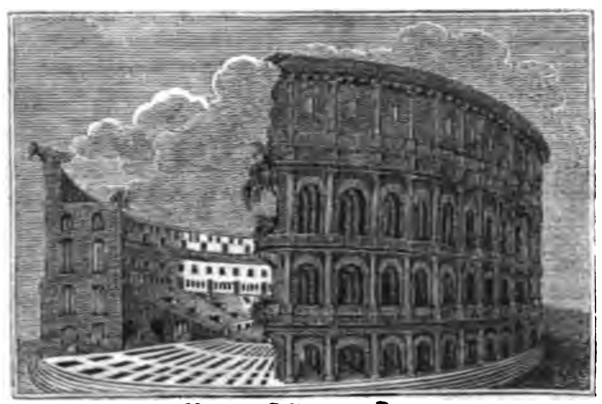
Shoemadoo is a pyramidical building composed of brick and mortar, without excavation or aperture of any sort; octagonal at the base, and spiral at the top; each side of the base measures 162 feet; this immense breadth diminishes abruptly, and a similar building has not unaptly been compared in shape to a large speaking trumpet.

Six feet from the ground there is a wide projection that surrounds the base, on the plane of which are fifty-seven small spires of equal size, and equidistant; one of them measured twenty-seven feet in height, and forty in circumference at the bottom. On a higher ledge there is another row consisting of fifty-three spires of similar shape and measurement.

A great variety of mouldings encircle the building;



No. 72.—Temple of Shoemadoo in Pegu.



No. 75.—Coliseum at Rome.

and ornaments some what resembling the fleur-de-lys surround the lower part of the spire; circular mouldings likewise girt it to a considerable height, above which there are ornaments in stucco not unlike the leaves of a Corinthian capital; and the whole is crowned by a Tee, or umbrella, of open iron-work, from which rises a rod with a gilded pennant.

The tee or umbrella is to be seen on every sacred building that is of a spiral form; the raising and consecration of this last and indispensible appendage, is an act of high religious solemnity, and a season of festivity and relaxation. The present king bestowed the tee that covers Shoemadoo. It was made at the capital; and many of the principal nobility came down from Ummerapoora to be present at the ceremony of its elevation.

The circumference of the tee is fifty-six feet; it rests on an iron axis fixed in the building, and is farther secured by large chains strongly rivetted to the spire. Round the lower rim of the tee are appended a number of bells, which agitated by the wind, make a continual jingling.

The tee is gilt, and it is said to be the intention of the king to gild the whole of the spire. All the lesser pagodas are ornamented with proportionable umbrellas of similar workmanship, which are likewise encircled by small bells.

The extreme height of the edifice, from the level of the country, is 361 feet, and above the interior terrace, 331 feet.

On the south-east angle of the upper terrace there are two handsome saloons, or kioums, lately erected, the roofs composed of different stages, supported by pillars; we judged the length of each to be about sixty feet, and the breadth thirty: the ceiling of one is already embellished with gold leaf, and the pillars are lackered; the decoration of the other is not yet completed. They are made entirely of wood; the carving on the outside is laborious and minute: we saw several unfinished figures of animals and men in grotesque attitudes, which were designed as ornaments for different parts of the building. Some images of Gaudma, the supreme object of Birman adoration, lay scattered around.

At each angle of the interior and higher terrace, there

is a temple 67 feet high, resembling, in miniature, the great temple: in front of that, in the south-west corner, are four gigantic representations, in masonry, of Palloo, or the evil genius, half beast, half human, seated on their hams, each with a large club on the right shoulder. The Pundit who accompanied me, said that they resembled the Rakuss of the Hindoos. These are guardians of the temple.

Nearly in the centre of the east face of the area are two human figures in stucco, beneath a gilded umbrella; one, standing, represents a man with a book before him and a pen in his hand; he is called Thasiamee, the recorder of mortal merits and mortal misdeeds; the other, a female figure kneeling, is Mahasumdera, the protectress of the universe, so long as the universe is doomed to last; but when the time of general dissolution arrives, by her hand the world is to be overwhelmed and everlastingly destroyed.

A small brick building near the north-east angle contains an upright marble slab, four feet high, and three feet wide: there is a long legible inscription on it. I was told it was an account of the donations of pilgrims of only a recent date.

Along the whole extent of the north face of the upper terrace, there is a wooden shed for the convenience of devotees who come from a distant part of the country. On the north side of the temple are three large bells of good workmanship, suspended nigh the ground, between pillars; several deers' horns lie strewed around; those who come to pay their devotions first take up one of the horns, and strike the bell three times, giving an alternate stroke to the ground: this act, I was told, is to announce to the spirit of Gaudma the approach of a suppliant. There are several low benches near the foot of the temple, on which the person who comes to pray, places his offering, commonly consisting of boiled rice, a plate of sweetmeats, or cocoa-nut fried in oil; when it is given, the devotee cares not what becomes of it; the crows and wild dogs often devour it in presence of the donor, who never attempts to disturb the animals. I saw several plates of victuals disposed of in this manner, and understood it to be the case with all that was brought.

There are many small temples on the areas of both terraces, which are neglected, and suffered to fall into decay. Numberless images of Gaudma lie indiscriminately scattered. A pious Birman who purchases an idol, first procures the ceremony of consecration to be performed by the Rhahaans; he then takes his purchase to whatever sacred building is most convenient, and there places it in the shelter of a kioum, or on the open ground before the temple; nor does he ever again seem to have any anxiety about its preservation, but leaves the divinity to shift for itself. Some of those idols are made of marble that is found in the neighbourhood of the capital of the Birman dominions, and admits of a very fine polish; many are formed of wood, and gilded, and a few are of silver; the latter, however, are not usually exposed and neglected like the others. Silver and gold is rarely used, except in the composition of household gods.

On both the terraces are a number of white cylindrical flags, raised on bamboo poles; these flags are peculiar to the Rhahaans, and are considered as emblematical of purity, and of their sacred function. On the top of the staff there is a henza, or goose, the symbol both of the Birman and Pegu nations.

THE COLOSSAL FIGURE OF JUPITER PLUVIUS, OR STATUE OF FATHER APPENINE, AT PRATOLINO, IN ITALY.

[*See Plate, No.* 74.]

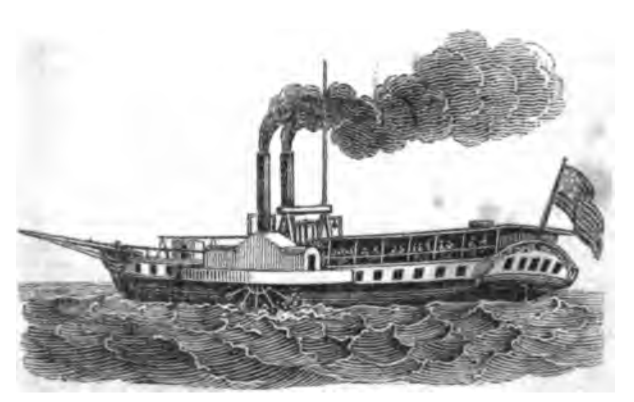
Statues above the ordinary size, were named by the ancients, *Colossi*, from a Greek word which signifies 'Members.' That at Rhodes was the most famous, executed by Carelus, a pupil of Lysippus. There were several at Rome; the most considerable was that of Vespasian, in the amphitheatre, that bore the name of Colisæa. Claudius caused a colossal statue of himself to be raised on a rock exposed to the sea waves, in front of the port of Ostium. Nero had his person and figure painted on a linen cloth, 120 feet in height. In the Court of the Capitol, and in the Place Farnesi, &c. are colossi, either entire or mutilated.

The space in which stands this enormous statue, is planted round, on all sides, with lofty fir and beech trees, the trunks of which are hid by a wood of laurel, wherein





No. 77.—Aqueduct of the Peat Forest Canal.



No. 86.—Steam Boat.

nitude is best shewn by comparison with the groupes promenading about the water, and which in comparison, at a certain distance, resemble pigmies. A nearer approach exhibits a truly striking proportion of the limbs.

A number of apartments have been fabricated in the interior, and within the head is a beautiful belvidere, wherein the eye-balls serve for windows. The extremities are of stone; the trunk is of bricks overlaid with a mortar or cement that has contracted the hardness of marble, and which, when fresh, it was easy to model in due forms.

It is related in the life of John of Bologna, that several of his pupils, unaccustomed to work with hand, while engaged in this work, forgot the correct standard of dimensions, both as to the eye and hand, and that Father Appenine and his enormous muscles made them spoil a number of statues.

The greatest difficulty in the workmanship was to impress on the mass, the character of monumental durability. The artist has succeeded in uniting the rules of the statuary with those of construction, in combining the beauty of the one with the solidity of the other. All the parts refer to a common centre of gravity, and the members are arranged so as to serve for a scaffolding to the body, without impairing its dignity or magnitude.

The colossal statues of the ancients may have suggested the idea of this configuration, or, as before hinted, the artist may have aimed to represent the Jupiter Pluvius. However, it seems probable that Poussin, in his painting of the Plains of Sicily, has, from this, formed his Polyphemus, seated on the summit of a lofty rock. From the beauty of its proportions, and skill in the execution, all artists who have to work on colossal figures, ought to cherish the preservation of this, as an imposing object, that cannot be too profoundly studied.

THE HANGING TOWER OF PISA, IN TUSCANY.

This celebrated tower, likewise called Campanile, on account of its having been erected for the purpose of containing bells, stands in a square close to the cathedral of Pisa. It is built entirely of white marble, and is a beautiful cylinder of eight stories, each adorned with a round of

columns, rising one above another. It inclines so far on one side from the perpendicular, that in dropping a plummet from the top, which is 188 feet in height, it falls 16 feet from the base. Much pains have been taken by connoisseurs to prove that this was done purposely by the architect; but it is evident that the inclination has proceeded from another cause, namely, from an accidental subsidence of the foundation on that side. The pillars are there considerably sunk; and this is also the case with the very threshold of ambition, meant to shew how far he could with safety deviate from the perpendicular, and thus display a novel specimen of his art, he would have shortened the pilasters on that side, so as to exhibit them entire, without the appearance of sinking.

THE COLISEUM AT ROME.

[*See Plate, No.* 75.]

On approaching the majestic ruins of this vast amphitheatre, the most stupendous work of the kind antiquity can boast, a sweet and gently-moving astonishment is the first sensation which seizes the beholder; and soon afterwards the grand spectacle swims before him like a cloud. To give an adequate idea of this sublime building, is a task to which the pen is unequal: it must be seen to be duly appreciated. It is upwards of 1600 feet in circumference, and of such an elevation that it has been justly observed by a writer, Ammiamus, "the human eye scarcely measures its height." Nearly the one half of the external circuit still remains, consisting of four tiers of arcades, adorned with columns of four orders, the Doric, Ionian, Corinthian, and Composite. Its extent may, as well as its elevation, be estimated by the number of spectators it contained, amounting according to some accounts, to eighty thousand, and agreeably to others, to one hundred thousand.

Thirty thousand captive Jews are said to have been engaged by Vespasian, whose name it occasionally bears, in the construction of this vast edifice; and they have not discredited their forefathers, the builders of Solomon's temple, by the performance. It was not finished, however, until the reign of his son Titus, who, on the first day of its being opened introduced into the arena not less than 5000, or, according to Dio Cassius, 9000 wild beasts, between whom,

and the primitive Christians held captive by the Romans, combats were fought. At the conclusion of this cruel spectacle the whole place was put under water, and two fleets, named the Corcyrian and the Corinthian, represented a naval engagement. To render the vapour from such a multitude of persons less noxious, sweet-scented water, and frequently wine mixed with saffron, was showered down from a grated work above, on the heads of the spectators.

The Roman Emperors who succeeded Titus were careful of the preservation of this superb edifice: even the voluptuous Heliogabulus caused it to be repaired after a great fire. The rude Goths, who sacked the city of Rome, were contented with despoiling it of its internal ornaments, but respected the structure itself. The Christians, however, through an excess of zeal, have not been satisfied with allowing it gradually to decay. Pope Paul II. had as much of it levelled as was necessary to furnish materials for building the palace of St. Mark, and his pernicious example was imitated by Cardinal Riario, in the construction of what is now called the chancery. Lastly, a portion of it was employed by Pope Paul III. in the erection of the Palace Farnese. Notwithstanding all these dilapidations, there still exists enough of it to inspire the spectator with awe. Immense masses appear fastened to and upon one another without any mortar or cement; and these alone, from their structure, are calculated for a duration of many thousands of years. Occasionally, where the destroyers have not effectually attained their object, the half-loosened masses appear to be holden in the air, by some invisible power; for the wide interstices among them leave no other support than their joints, which seem every moment as if about to yield unavoidably to the superior force of gravitation. "They will fall;" "they must fall;" "they are falling;" is, and has been the language of all beholders during the vast periods through which this stupendous edifice has thus hung together in the air.

ROMAN AMPHITHEATRE AT NISMES.

Nismes, anciently called Nemausis, in the province of Lower Languedoc, was a very flourishing colony of Romans, established by Augustus Cesar, after the battle of

Actium. Among its splendid monuments of antiquity, the Amphitheatre, being infinitely better preserved than those of Rome and Verona, is the finest monument of the kind now extant. It was built in the reign of Antoninus Pius, who contributed a large sum of money towards its erection. It is of an oval figure, 1080 feet in circumference, sufficiently capacious to contain twenty thousand spectators. The architecture is of the Tuscan order, sixty feet high, composed of two open galleries, built one over another, consisting each of sixty arcades. The entrance into the arena was by four great gates, with porticoes; and the seats, of which there were thirty, rising one above another, consisted of great blocks of stone, many of which still remain. Over the north gate, appear two bulls, in alto-relievo, extremely well executed, emblems which, according to the usage of the Romans, signified that the amphitheatre was erected at the expence of the people. In other parts are heads, busts, and other sculptures in bass-reliefs.

This magnificent structure stands in the lower part of the city, and strikes the spectator with awe and veneration. The external architecture is almost entire in its whole circuit. It was fortified as a citadel by the Visigoths, in the beginning of the sixth century: they raised within it a castle, two towers of which are still extant; and surrounded it with a broad and deep moat, which was filled up in the thirteenth century. In all the subsequent wars to which the city of Nismes was exposed, it served as the last refuge of the citizens, and sustained a great number of successive attacks; so that its fine preservation is almost miraculous.

TRAJAN'S PILLAR.

This historical column was erected at Rome by the Emperor Trajan to commemorate his victories over the Dacians, and is considered the master-piece of the splendid monuments of art elevated by that Emperor in the Roman capital. Its celebrity is chiefly owing to the beautifully-wrought bass-reliefs, containing about two thousand figures, with which it is ornamented. It stands in the middle of a square, to form which a hill, one hundred and forty feet in height, was levelled; and was intended, as appears by the inscription on its base, both as a tomb for the Emperor, and to display the height of the hill, which had thus with

incredible labour, been reduced to a plane surface. It was erected in the year 114 of the Christian era; and the Emperor Constantine, two centuries and a half afterwards, regarded it as the most magnificent structure by which Rome was even at that time embellished.

This pillar is built of white marble, its base consisting of twelve stones of enormous size, being raised on a socle, or foot of eight steps; withinside is a staircase illuminated by 44 windows. Its height, equalling that of the hill which had been levelled, to give place to the large square called THE FORUM ROMANUM, is 140 feet, being 35 feet less elevated than the Antonine column. The latter, the sculptured ornaments of which are not equally esteemed, is decorated with bass-reliefs representing the victories of Marcus Aurelius over the Marcomanni. A spiral stair-case of nearly 200 steps leads to the summit of this column.

MAISON CARREE, AT NISMES.

If the Amphitheatre of Nismes strikes the spectator with an idea of greatness and sublimity, the Maison Carree enchants him with the most exquisite beauties of architecture and sculpture. This fine structure, as is evidenced by the inscription discovered on its front, was built by the inhabitants of Nismes, in honour of Caius Cesar, and Lucius Cesar, grandchildren of Augustus, by his daughter Julia, the wife of Agrippa. It stands upon a pediment 6 feet high, is 82 feet long, 35 broad, and 37 in height, without reckoning the pediment. The body of it is adorned with 20 columns engaged in the wall; and the peristyle, which is open, with 10 detached pillars that support the entablature. They are all of the Corinthian order, fluted and embellished with capitals of the most exquisite sculpture: the frize and cornice are much admired, and the foilage is esteemed inimitable. The proportions of the building are so happily blended, as to give it an air of majesty and grandeur, which the most indifferent spectator cannot behold without emotion. To enjoy these beauties, it is not necessary to be a connoisseur in architecture: they are indeed so exquisite that they may be visited with a fresh appetite for years together. What renders them still more interesting is, that they are entire, and very little affected, either by the ravages of time, or the havoc of war. Cardinal Alberoni de-

clared this elegant structure to be a jewel which deserved a cover of gold to preserve it from external injuries. An Italian painter, perceiving a small part of the roof repaired by modern French masonry, tore his hair, and exclaimed in a rage, "Zounds! what do I see? Harlequin's hat on the head of Augustus!"

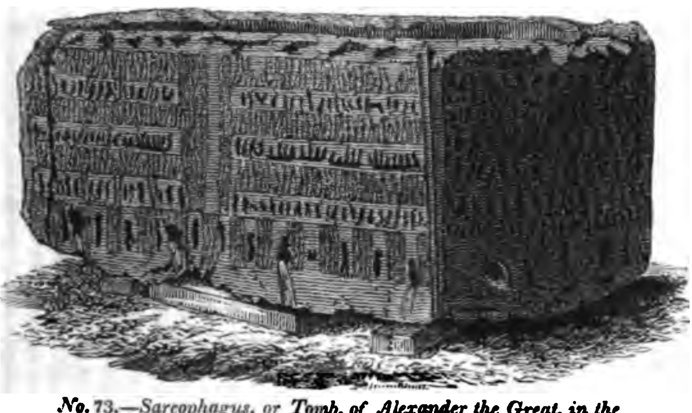
In its general architectural effect, as well as in all its details of sculpture and ornament, the Maison Carree of Nismes is ravishingly beautiful, and cannot be paralleled by any structure of ancient or modern times. That which most excites the astonishment of the admiring spectator, is to see it standing entire, like the effect of enchantment, after such a succession of ages, subjected as several of them were, to the ravages of the barbarians who overrun the most interesting parts of Europe!

THE PONT DU GARD.

[*See Plates, No.* 76, 77.]

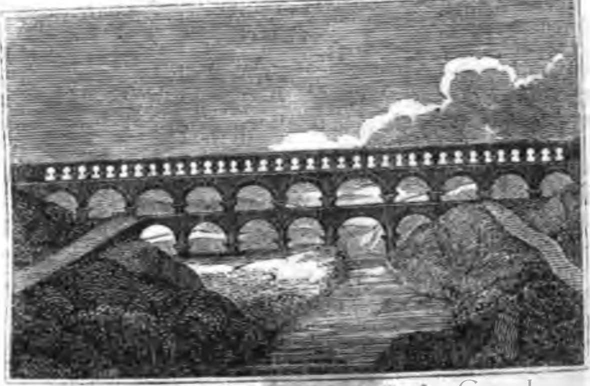
This celebrated Roman monument is distant about three leagues from the city of Nismes. Instead of finding it in a ruinous condition, as he might reasonably have expected, the traveller on approaching it, is agreeably disappointed when he perceives that it looks as fresh as a modern bridge of a few years standing. The climate is either so pure and dry, or the free-stone with which it is built is so hard, that the very angles of the stones remain as acute as if they had been recently cut. A few of them have, indeed, dropped out of the arches; but the whole is admirably preserved, and presents the eye with a piece of architecture, so unaffectedly elegant, so simple, and, at the same time, so majestic, that it defies the most phlegmatic spectator to view it without admiration. It was raised in the Augustan age, by the Roman Colony of Nismes, to convey a stream of water between two mountains, for the use of that city. It stands over the river Gardon, a beautiful pastoral stream, brawling among rocks which form a number of pretty natural cascades, and overshadowed on each side by trees and shrubs, which add greatly to the rural beauties of the scene.

This elegant structure consists of three bridges, or tiers of arches, one above another; the first of six, the second of eleven, and the third of thirty-six arches. The height, comprehending the aqueduct on the top, is 174 feet 3 inch-



No. 73.—*Sarcophagus, or Tomb, of Alexander the Great, in the British Museum,* *described Page* 628.

No. 58.—Section of the Pyramid of Djiza.



No. 76.—The Pont du Gard.

es, and the length, between the two mountains, which it unites, is 723 feet. The order of the architecture is Tuscan; but its symmetry is inconceivable. By scooping the bases of the pilasters of the second tier of arches, a passage was made for foot travellers; but although the ancients far excelled the moderns in point of beauty and magnificence, they certainly fell short of them in point of convenience. The inhabitants of Avignon have, in this particular, improved the Roman work by a new bridge by apposition, constructed on the same plan with that of the lower tier of arches, of which indeed it seems to be a part, affording a broad and commodious passage over the river, to horses and carriages. The aqueduct for the continuance of which this superb work was raised, conveyed a stream of pure water from the fountain of Eure, near the city of Uzes, and extended nearly six leagues in length.

To enable the reader to form a comparative judgement of ancient and modern aqueducts, a delineation of the one at the Peat Forest Canal, stretching from the great Canal which extends from Manchester towards Wakefield, is introduced in the Plate, beneath that of the Pont du Gard.

ST. PETER'S OF ROME.

[*See Plate, No.* 62.]

The piazza of this masterpiece of architecture is altogether sublime. The double colonnade on each side, extending in a semi-circular sweep; the stupendous Egyptian obelisk; the two fountains; the portico; and the admirable façade of the church; form such an assemblage of magnificent objects, as cannot fail to impress the mind with awe and admiration. The church appears in the back-ground, and on each side is a row of quadruple arches, resting on two hundred and eighty-four pillars, and eighty-eight pilasters; the arches support one hundred and ninety two statues, twelve feet in height. The two noble fountains throw a mass of water to the height of nine feet, from which it falls in a very picturesque manner, and adds greatly to the beauty of the scene. In the centre is the fine obelisk.

At the first entrance into St. Peter's, the effect is not so striking as might be expected: it enlarges itself however, insensibly on all sides, and mends on the eye every moment. The proportions are so accurately observed, that each of

the parts are seen to an equal advantage, without distinguishing itself above the rest. It appears neither extremely high, nor long, nor broad, because a just equality is preserved throughout. Although every object in this church is admirable, the most astonishing part of it is the cupola. On ascending to it, the spectator is surprised to find, that the dome which he sees in the church, is not the same with the one he had examined without doors, the latter being a kind of case to the other, and the stairs by which he ascends into the ball lying between the two. Had there been the outward dome only, it would not have been seen to advantage by those who are within the church; or had there been the inward one only, it would scarcely have been seen by those who are without; and had both been one solid dome of so great a thickness, the pillars would have been too weak to have supported it.

It is not easy to conceive a more glorious architectural display than the one which presents itself to the spectator who stands beneath the dome. If he looks upward, he is astonished at the spacious hollow of the cupola, and has a vault on every side of him, which makes one of the most beautiful vistas the eye can possibly have to penetrate. To convey an idea of its magnitude, it will suffice to say, that the height of the body of the church, from the ground to the upper part of its ceiling, is four hundred and thirty-two feet, and that sixteen persons may place themselves, without inconvenience, in the globular top over the dome, which is annually lighted, on the 29th of June, by four thousand lamps and two thousand fire-pots, presenting a most delightful spectacle.

The vestibule of St. Peter's is grand and beautiful. Over the second entrance is a fine mosaic from Giotto, executed in the year 1303; and at the corners, to the right and left, are the equestrian statues of Constantine and Charlemagne. Of the five doors leading to the church itself, one, called the holy door, is generally shut up by brick-work, and is only opened at the time of the Jubilee. The middle gate is of bronze, with bass-reliefs.

Of the one hundred and thirty statues with which this church is adorned, that of St. Peter is the most conspicuous: it is said to have been recast from a bronze statue of Jupiter Capitolinus. One hundred and twelve lamps are constant-

ly burning around the tomb of this Saint; and the high altar close to it, on which the Pope alone reads mass, is overshadowed by a ceiling, which exceeds in loftiness that of any palace of Rome. The splendid sacristy was built by Pius VI. But by far the greatest ornaments of the interior are the excellent works in mosaic, all copied from the most celebrated pictures, which are thus guarded from oblivion.

The great and truly awful dome of St. Peter's is only two feet less in diameter than that of the Pantheon, being one hundred and thirty-seven feet; but it exceeds the latter in height by twenty feet, being one hundred and fifty-nine feet, besides the lantern, the basis pedestal of the top, the globular top itself, and the cross above it, which, collectively, measure one hundred and twenty feet. The roof of the church is ascended by easy steps; and here the visitor seems to have entered a small town, for he suddenly finds himself among a number of houses, which either serve as repositories of implements and materials for repairing the church, or are inhabited by the workmen. The dome, at the foot of which he now arrives, appears to be the parish-church of this town; and the inferior domes seem as if intended only for ornaments to fill up the vacuities. Add to this, that he cannot see the streets of Rome, on account of the surrounding high gallery, and its colossal statues; and the singularity of such a scene may be easily conceived. It is besides said, that a market is occasionally held here for the aerial inhabitants.

Although the adventurous stranger is now on the roof, he has still a great height to ascend before he reaches the summit of the dome. Previously to his engaging in this enterprise, he is conducted to the inside gallery of the dome. From this spot the people within the body of the church appear like children. The higher he goes, the more uncomfortable he finds himself, on account of the oblique walls over the narrow staircase; and he is often compelled to lean with his whole body quite to one side. Several marble plates are affixed in these walls, containing the names of the distinguished personages who have had the courage to ascend to the dome, and even to climb up to the lantern, and the top. The Emperor Joseph II. is twice mentioned; and Paul I. as Grand Duke. In some parts, where the stairs are too steep, more commodious steps of

wood have been placed: by these the lantern can be reached with greater facility; and the view which there waits the visitor, may be imagined without the aid of description; it is AN IMMENSE PANORAMA, BOUNDED BY THE SEA.

EDDYSTONE LIGHT-HOUSE.

[*See Plate, No.* 78.]

THE Eddystone Rocks, on which this celebrated Light-house is built, are situated nearly south-south-west from the middle of Plymouth-sound, being distant from the port of Plymouth nearly fourteen miles, and from the Promontory called Ramhead, about ten miles. They are almost in the line, but somewhat within it, which joins the Start and the Lizard Points; and as they lie nearly in the direction of vessels coasting up and down the Channel, they were necessarily, before the establishment of a light-house, very dangerous, and often fatal to ships under such circumstances. Their situation, likewise, relatively to the Bay of Biscay and the Atlantic Ocean, is such that they lie open to the swells of both from all the south-western points of the compass; which swells are generally allowed by mariners to be very great and heavy in those seas, and particularly in the Bay of Biscay. It is to be observed, that the soundings of the sea, from the south-west towards the Eddystone, are from eighty fathoms to forty, and that in every part, until the rocks are approached, the sea has a depth of at least thirty fathoms; insomuch that all the heavy seas from the south-west reach them uncontrouled, and break on them with the utmost fury.

The force and height of these seas are increased, by the circumstance of the rocks stretching across the channel, in a direction north and south, to the length of above one hundred fathoms, and by their lying in a sloping manner toward the south-west quarter. This striving of the rocks, as it is technically called, does not cease at low-water, but still goes on progressively; so that, at fifty fathoms westward, there are twelve fathoms of water; neither does it terminate at the distance of a mile. From this configuration it happens, that the seas are swollen to such a degree, in storms and heavy gales of wind, as to break on the rocks with the utmost violence.

It is not surprising, therefore, that the dangers to which

navigators were exposed by the Eddystone rocks should have made a great commercial nation desirous to have a light-house erected on them. The wonder is that any one should have had sufficient resolution to undertake its construction. Such a man was, however, found in the person of Mr. Henry Winstanley, of Littleburgh, in Essex, who, being furnished with the necessary powers to carry the design into execution, entered on his undertaking in 1696, and completed it in four years. So certain was he of the stability of his structure, that he declared it to be his wish to be in it "during the greatest storm which ever blew under the face of the heavens." In this wish he was but two amply gratified; for while he was there with his workmen and light-keepers, that dreadful storm began, which raged most violently on the night of the 26th of November, 1703; and of all the accounts of the kind with which history has furnished us, not any one has exceeded this in Great Britain, nor has been more injurious or extensive in its devastations. On the following morning, when the storm was so much abated, that an enquiry could be made, whether the lighthouse had suffered from it, not any thing appeared standing, with the exception of some of the large irons by which the work was fixed on the rock; nor were any of the people, nor any of the materials of the building ever found afterwards.

In 1709, another light-house was built of wood, on a very different construction, by Mr. John Rudyerd, then a silk-mercer on Ludgate-hill. This very ingenious structure, after having braved the elements for forty-six years, was burned to the ground in 1755. On the destruction of this light-house, that excellent mechanic and engineer Mr. Smeaton, was selected as the fittest person to build another. He found some difficulty in persuading the proprietors, that a stone building, properly constructed, would be in every respect preferable to one of wood; but having at length convinced them, he turned his thoughts to the shape which would be more suitable to a building so critically situated. Reflecting on the structure of the former buildings, it seemed to him a material improvement to procure, if possible, an enlargement of the base, without increasing the size of the waist, or that part of the building placed between the top of the rock and the top of the solid work. Hence he

thought a greater degree of strength and stiffness would be gained, accompanied with less resistance to the acting power. On this occasion, the natural figure of the waist, or bole of a large spreading oak, occurred to our sagacious engineer.

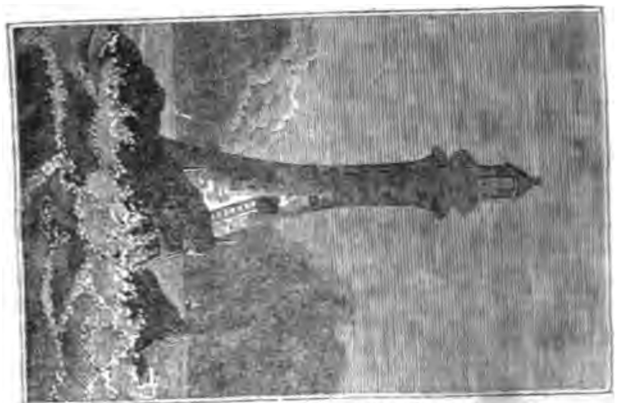
With those very enlightened views, as to the proper form of the superstructure, Mr. Smeaton began the work on the 2d of April, 1757, and completed it on the 4th of August, 1759. The rock which slopes towards the south-west, is cut into horizontal steps, into which are dovetailed, and united by a strong cement, Portland-stone and granite.—The whole to the height of thirty-five feet from the foundation, is a solid body of stones, engrafted into each other, and united by every means of additional strength that could be devised. The building has four rooms, one over the other, and at the top a gallery and lantern. The stone floors are flat above, but concave beneath, and are kept from pressing against the sides of the building by a chain let into the walls. It is nearly eighty feet in height, and since its completion has been assaulted by the fury of the elements, without suffering the smallest injury.

To trace the progress of so vast an undertaking, and to show with what skill and judgement this unparalleled engineer overcame the greatest difficulties, would far exceed the limits of this work.

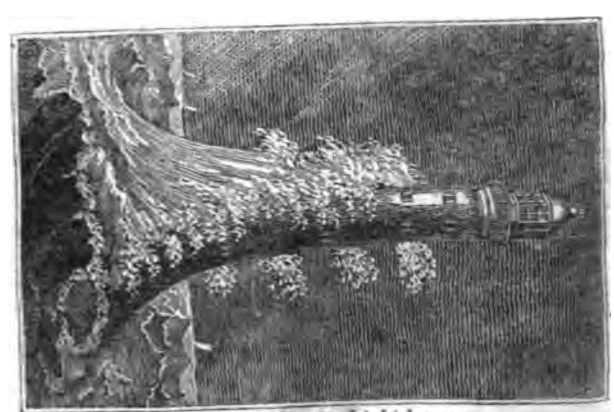
BELL ROCK LIGHT-HOUSE.

[*See Plate, No.* 78]

The Bell Rock, or Inch Cape, is situated on the north-east coast of Great Britain, twelve miles south-west from the town of Arbroath, in Fifeshire, and thirty miles north-east from St. Abb's Head, in the county of Berwick. It lies in the direct trace of the Firth of Tay, and of a great proportion of the shipping of the Frith of Forth, embracing a very extensive local trade. This estuary is besides the principal inlet on the northern coast of Britain, in which the shipping of the German Ocean and North Sea take refuge when overtaken by easterly storms. At neap-tides, or at the quadratures of the moon, the Bell Rock is scarcely uncovered at low-water; but in spring-tides, when the ebbs are greatest, that part of the rock which is exposed to view at low-water, measures about four hundred and twenty-seven



No. 78.—Bell Rock Light-house.



No. 79.—Eddystone Light-house.

feet in length, by two hundred and thirty in breadth; and in this low state of the tides, its average perpendicular height above the surface of the sea is about four feet. Beyond the space included in these measurements, at very low tides, a reef extends about a thousand feet in a south-west direction, from the higher part of the rock just described; and on this reef the light-house is erected.

In the erection of a light-house on the Bell Rock, independently of its distance from the main land, a serious difficulty presented itself, arising from the greater depth of water at which it was necessary to carry on the operations, than in the case of the Eddystone light-house, described above, or of any other building of the same kind, ancient or modern, which had been hitherto undertaken. Its description is as follows:

The Bell Rock Light-house, which has not improperly, been termed the Scottish Pharos, is a circular building, the foundation stone of which is nearly on a level with the surface of the sea at low water of ordinary spring tides; and, consequently, at high-water of these tides the building is immersed to the height of about fifteen feet. The first two, or lowest courses of the masonry, are imbedded, or sunk into the rock, and the stones of all the courses are curiously dovetailed and joined with each other, forming one connected mass from the centre to the circumference. The successive courses of the work are also attached to each other by joggles of stone; and, to prevent the stones from being lifted up by the force of the sea, while the work was in progress, each stone of the solid part of the building had two holes bored through it, entering six inches into the course immediately below, into which oaken tree-nails, two inches in diameter, were driven, after Mr. Smeaton's plan at the Eddystone Light-house. The cement used at the Bell Rock, like that at the latter, was a mixture of puzzolano, earth, lime, and sand, in equal parts, by measure.

The stones employed in this surprising structure weigh from two tons to half a ton each. The ground course measures forty-two feet in diameter, and the building diminishes as it rises to the top, where the parapet wall of the light-room has a diameter of thirteen feet only. It is solid from the ground course to the height of thirty feet, where the entry door is placed, the ascent to which is by a

kind of rope-ladder, with wooden steps, hung out at ebb-tide, and taken into the building again when the water covers the rock; but strangers to this sort of climbing are taken up in a kind of chair, by a small moveable crane projected from the door, from which a narrow passage leads to a stone staircase thirteen feet in height. Here the walls are seven feet thick; but they gradually diminish from the top of the staircase to the parapet wall of the light-room, where they measure one foot only in thickness. The upper part of the building is divided into six apartments for the use of the light-house keepers, and for containing the light-house stores. The lower, or first of these floors, contains the water-tanks, fuel, and other bulky articles; the second, the oil-cisterns, glass, and other light-room stores; the third is occupied as a kitchen; the fourth is the bed-room; the fifth, *the library*, or stranger's room; and the upper apartment forms the light-room. The floors of the several apartments are of stone, and the communication from the one to the other is effected by wooden ladders, except in the case of the light-room, where every article being fire-proof, the steps are made of iron. In each of the three lower apartments are two windows; but the upper rooms have four windows each. The casements of the windows are double, and are glazed with plate-glass, having besides an outer storm-shutter, or *dead-light*, of timber, to defend the glass from the waves and spray of the sea. The parapet wall of the light-room is six feet in height, and has a door leading out to the balcony, or walk, formed by the cornice round the upper part of the building, which is surrounded by a cast-iron rail, curiously wrought like net-work. This rail reposes on batts of brass, and has a massive coping, or top-rail, of the same metal.

The light-room was, with the whole of its apparatus, framed and prepared at Edinburgh. It is of an octagonal figure, measuring twelve feet across, and fifteen feet in height, formed with cast-iron sashes, or window-frames, glazed with large plates of polished glass, measuring about two feet six inches, by two feet three, and the fourth of an inch in thickness. It is covered with a dome roof of copper, terminating in a large gilt ball, with a vent-hole in the top.

The light is very powerful, and is readily seen at the dis-

tance of seven leagues, when the atmosphere is clear. It is from oil, with Argand burners, placed in the focus of silver plated reflectors, measuring two feet over the lips, the silver surface being hollowed, or wrought to the parabolic curve. To the end that this splendid light may be the more easily distinguished from all the other lights on the coast, the reflectors are ranged on a frame with four faces, or sides, which, by a train of machinery, is made to revolve on a perpendicular axis once in six minutes. Between the observer and the reflectors, on two opposite sides of the revolving frame, shades of red glass are interposed in such a manner, that, during each entire revolution of the reflectors, two appearances, distinctly differing from each other, are produced: one is the common *bright light* familiar to all; but on the other, or shaded sides, the rays are tinged of a *red colour*. These red and bright lights, in the course of each revolution, alternate with intervals of darkness, which, in a very beautiful and simple manner, characterize this light.

As a farther warning to the mariner in foggy weather, two large bells, each weighing about twelve hundred, are tolled day and night by the same machinery which moves the lights. As these bells, in moderate weather, may be heard considerably beyond the limits of the rock, vessels, by this expedient, get warning to put about, and are thereby prevented from running on the rock in thick and hazy weather, a disaster to which ships might otherwise be liable, notwithstanding the erection of the light-house.

The establishment consists of a principle light-keeper, with three assistants, two of whom are constantly at the light-house, while the third is stationed at a tower erected at Arbroath, where he corresponds by signals with the light-keepers at the rock.

This stupendous undertaking is highly creditable to Mr. Stevenson, the engineer, and does honour to the age in which it has been produced. The lights were exhibited, for the first time, on the 1st of February, 1811.

STONEHENGE.

[*See Plate, No.* 60.]

This celebrated monument of antiquity stands in the middle of a flat area near the summit of a hill, six miles distant

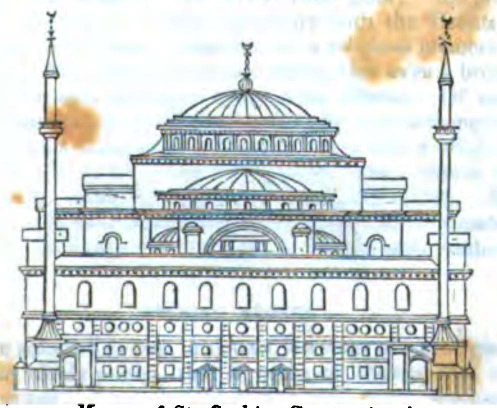
from Salisbury. It is inclosed by a double circular bank and ditch, nearly thirty feet broad, after crossing which an ascent of thirty yards leads to the work. The whole fabric was originally composed of two circles and two ovals.—The outer circle is about 108 feet in diameter, consisting, when entire, of sixty stones, thirty uprights, and thirty imposts, of which there now remain twenty-four uprights only, seventeen standing, and seven down, three feet and a half asunder, and eight imposts. Eleven uprights have their five imposts on them at the grand entrance: these stones are from thirteen to twenty feet high. The smaller circle is somewhat more than eight feet from the inside of the outer one, and consisted of forty smaller stones, the highest measuring about six feet, nineteen only of which now remain, and only eleven standing. The walk between these two circles is 300 feet in circumference. The *adytum*, or cell is an oval formed of ten stones, from sixteen to twenty-two feet high, in pairs, and with imposts above thirty feet high, rising in height as they go round, and each pair separate, and not connected as the outer pair: the highest eight feet.—Within these are nineteen other smaller single stones, of which six only are standing. At the upper end of the adytum is the altar, a large slab of blue coarse marble, 20 inches thick, sixteen feet long, and four broad: it is pressed down by the weight of the vast stones which have fallen upon it. The whole number of stones, uprights and imposts, comprehending the altar, is 140. The stones, which have been by some considered artificial, were most probably brought from those called the *grey weathers* on Marlborough Downs, distant fifteen or sixteen miles; and if tried with a tool, appear of the same hardness, grain and colour, generally reddish. The heads of oxen, deer and other beasts, have been found in digging in and about Stonehenge: and in the circumjacent barrows human bones. From the plain to this structure there are three entrances, the most considerable of which is from the north-east; and at each of them were raised, on the outside of the trench, two huge stones, with two smaller parallel ones within.

Geoffrey of Monmouth, in his history of the Britons, written in the reign of King Stephen, represents this monument as having been erected at the command of Aurelius Ambrosius, the last British king, in memory of 460 Britons

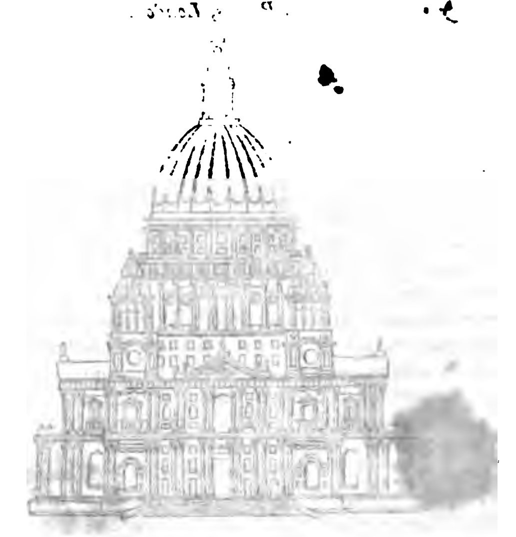
St. Paul's, London.



The exact relative dimensions of *St. Paul's*, at London, and the Mosque of *Saint Sophia*, at Constantinople.



Mosque of St. Sophia, Constantinople.



... mension of St. Paul's at Lon...
... Sophia, at Constantin...



... Sophia, Constantinople ...

who were murdered by Hengist the Saxon. Polydore Virgil says that it was erected by the Britons as the sepulchral monument of Aurelius Ambrosius; and other writers consider it to have been that of the famous British queen Boadicea. Inigo Jones is of opinion that it was a Roman temple; and this conclusion he draws from a stone sixteen feet in length, and four in breadth, placed in an exact position to the eastward, altar-fashion. By Charlton it is ascribed to the Danes, who were two years master of Wiltshire; a tin tablet, on which were some unknown characters, having been dug up in the vicinity, in the reign of Henry VIII. This tablet, which is lost, might have given some information respecting its founders. Its common name, STONEHENGE, is Saxon, and signifies a "stone gallows," to which the stones, having tranverse imposts, bear some resemblance. It is also called in Welch *choir gour*, or the giants' dance.

Mr. Grose, the antiquary, is of opinion that Doctor Stukely has completely proved this structure to have been a British temple, in which the Druids officiated. He supposes it to have been the metropolitan temple of Great Britain, and translates the words *choir gour*, "the great choir or temple." It was customary with the Druids to place one large stone on another for a religious memorial; and these they often placed so equably, that even a breath of wind would sometimes make them vibrate. Of such stones one remains at this day in the pile of Stonehenge.—The ancients distinguished stones erected with a religious view, by the name of *ambrosiae petrae*, *amber stones*, the word *amber* implying whatever is solar and divine. According to Bryant, Stonehenge is composed of these amber stones; and hence the next town is denominated Ambresbury.

ROCKING STONES.

THE ROCKING STONE, OR LOGAN, is a stone of a prodigious size, so nicely poised, that it rocks or shakes with the smallest force. Several of the consecrated stones mentioned above, were rocking stones; and there was a wonderful monument of this kind near Penzance in Cornwall, which still retains the name of *main-amber*, or the sacred stones. With these stones the ancients were not unacquainted.

Pliny relates that at Harpasa, a town of Asia, there was a rock of such a wonderful nature, that, if touched with the finger, it would shake, but could not be moved from its place with the whole force of the body. Ptolemy Hephistion mentions a stone of this description near the Ocean, which was agitated when struck by the stalk of the plant asphodel, or day lily, but could not be removed by a great exertion of force. Another is cited by Apollonius Rhodius, supposed to have been raised in the time of the Argonauts, in the island Tenos, as the monument of the two-winged sons of Boreas, slain by Hercules; and there are others in China, and in other countries.

Many rocking stones are to be found in different parts of Great Britain; some natural, and others artificial, or placed in their position by human art. That the latter are monuments erected by the Druids cannot be doubted; but tradition has not handed down the precise purpose for which they were intended. In the parish of St. Leven, Cornwall, there is a promontory called Castle Treryn. On the western side of the middle group, near the top, lies a very large stone, so evenly poised, that a hand may move it from one side to the other; yet so fixed on its base, that not any lever, or other mechanical force, can remove it from its present situation. It is called the LOGAN-STONE, and is at such a height from the ground as to render it incredible that it was raised to its present position by art. There are, however, other rocking stones, so shaped and situated, that there cannot be any doubt of their having been erected by human strength. Of this kind the great QUOIT, or KARN-LE HAU, in the parish of Tywidnek, in Wales, is considered. It is 39 feet in circumference, and four feet thick at a medium, and stands on a single pedestal. In the Island of St. Agnes, Scilly, is a remarkable stone of the same kind. The under rock is 10½ feet high, 47 feet round the middle, and touches the ground with not more than half its base. The upper rock rests on one point only, and is so nicely balanced, that two or three men with a pole can move it. It is 8½ feet high, and 47 in circumference. On the top is a bason hollowed out, 3 feet 11 inches in diameter at a medium, but wider at the brim, and 3 feet in depth. From the globular shape of the upper stone, it is highly probable that it was rounded by human art, and perhaps even placed on its pedestal by human

strength. In Sithney parish, near Helston, in Cornwall, stood the famous logan, or rocking stone, commonly called *Men Amber*, that is, *Men an Bar*, or the *top stone*. It was 11 feet by 6, and 4 high, and so nicely poised on another stone, that a little child could move it. It was much visited by travellers; but Shrubsall, the Governor of Pendennis Castle, under Cromwell, caused it to be undermined, by the dint of much labour, to the great grief of the country. There are some marks of the tool on it; and it seems probable, by its triangular shape, that it was dedicated to Mercury.

ST. PAUL'S CATHEDRAL.

[*See Plate, No.* 80.]

THE chief ecclesiastical ornament of London is the Cathedral Church of St. Paul, which stands in the centre of the metropolis, on an eminence rising from the valley of the Fleet. The body of the church is in the form of a cross. Over the space where the lines of that figure intersect each other, rises a stately dome, from the top of which springs a lantern adorned with Corinthian columns, and surrounded at its base by a balcony; on the lantern rests a gilded ball, and on that a cross (gilt also) crowning the ornaments of the edifice. The length of the church, including the portico, is 510 feet; the breadth 282; the height to the top of the cross 404; the exterior diameter of the dome 145; and the entire circumference of the building 2,292 feet. A dwarf stone wall, supporting a ballustrade of cast iron, surrounds the church, and separates a large area, which is properly the church-yard, from a spacious carriage and foot-way on the south side, and a foot pavement on the north.

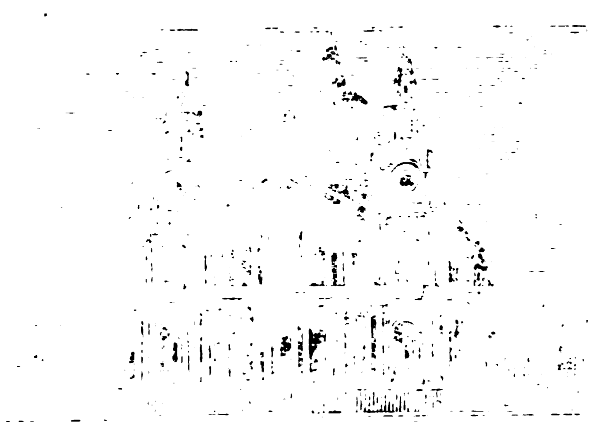
The dimensions of this cathedral are great; but the grandeur of the design, and the beauty and elegance of its proportions, more justly rank it among the noblest edifices of the modern world. It is adorned with three porticoes; one at the principal entrance, facing the west, and running parallel with the opening of Ludgate Street; and the other two facing the north and south, at the extremities of the cross aisle, and corresponding in their architecture. The western portico combines as much grace and magnificence as any specimen of the kind in the world. It consists of 12

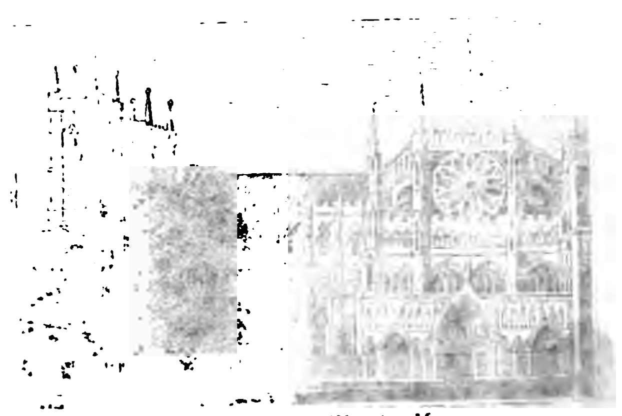
lofty Corinthian columns below, and 8 composite above, supporting a grand pediment; the whole resting on an elevated base, the ascent to which is by a flight of twenty-two square steps of black marble, running the entire length of the portico. The portico at the northern entrance consists of a dome, supported by six Corinthian columns, with an ascent of twelve circular steps, of black marble. The southern portico is similar, except that the ascent consists of twenty-five steps, the ground on that side being lower.

The great dome is ornamented with thirty-two columns below, and a range of pilasters above. At the eastern extremity of the church, is a circular projection, forming a recess within for the communion table. The walls are wrought in rustic, and strengthened and ornamented by two rows of coupled pilasters, one above the other, the lower being Corinthian, and the other composite. The northern and southern sides have an air of uncommon elegance. The corners of the western front are crowned with turrets of an airy and light form.

To relieve the heavy stile of the interior, statues and monuments have been erected to the memory of great men. The statues are plain full-length figures, standing on marble pedestals, with appropriate inscriptions, in honour of Doctor Samuel Johnson, the benevolent Howard, and Sir William Jones, of Asiatic celebrity. Several of the monuments would disgrace the most barbarous age, and ought to be removed. The tomb of the great Nelson is beneath the pavement immediately under the dome.

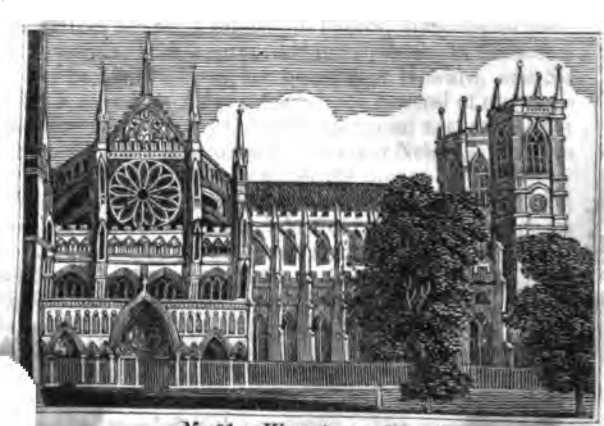
The two turrets on the right and left of the west front are each two hundred and eight feet in height. In one on the southern side is the great clock, the bell of which, weighing 11,474 pounds, and 10 feet in diameter, may be heard in the most distant part of London, when the wind blows towards that quarter. The entire pavement, up to the altar, is of marble, chiefly consisting of square slabs, alternately black and white, and is very justly admired. The floor round the communion table is of the same kind of marble, mingled with porphyry. The communion table has no other beauty; for, though it is ornamented with four fluted pilasters, which are very noble in their form, they are merely painted and veined with gold, in imitation of lapis lazuli. Eight Corinthian columns of blue and







No. 80.—St. Paul's Church.



No. 81.—Westminster Abbey.

white marble, of exquisite beauty, support the organ gallery. The stalls in the choir are beautifully carved, and the other ornaments are of equal workmanship.

This Cathedral was built at the national expence, and cost £736,752. The iron ballustrade on the wall surrounding the space that is properly the church-yard, which, with its seven iron gates, weigh 200 tons, cost £11,202. This immense edifice was reared in 35 years, the first stone being laid on the 21st of June, 1675, and the building completed in 1710, exclusive of some of the decorations, which were not finished till 1723. The highest stone of the lantern was laid on by Mr. Christopher Wren, son of the architect, in 1710. It was built by one architect, Sir *Christopher Wren*, by one mason, Mr. *Strong*; and while one prelate, Dr. *Henry Compton*, filled the see of London.

The dimensions of St. Paul's, from east to west, within the walls, are 510 feet; from north to south, within the doors of the porticoes, 282; the breadth of the west entrance, 100; its circuit, 2292; its height within, from the centre of the floor to the cross, 340 feet. The circumference of the dome is 430 feet; the diameter of the ball, 6; from the ball to the top of the cross, 30; and the diameter of the columns of the porticoes, 4 feet. The height to the top of the west pediment, under the figure of St. Paul, is 120 feet; and that of the tower of the west front, 287.

From the bottom of the whispering gallery are 280 steps; including those to the golden gallery, 534, and to the ball, in all, 616 steps.—The weight of the ball is 5600 pounds.—The weight of the cross is 3360.—The extent of the ground whereon this Cathedral stands, is two acres, 16 perches. The length of the hour figures 2 feet 2½ inches; the circumference of the dial is 57 feet.

The *Whispering Gallery* is a very great curiosity.—It is 140 yards in circumference. A stone seat runs round the gallery along the foot of the wall. On the side directly opposite the door by which the visitor enters, several yards of the seat are covered with matting, on which the visitor being seated, the man who shews the gallery whispers, with the mouth close to the wall, near the door, at the distance of 140 feet from the visitor, who hears his words in a loud voice, seemingly at his ear. The mere shutting of the door produces a sound to those on the opposite seat like violent

claps of thunder. The effect is not so perfect if the visitor sits down half way between the door and the matted seat, and still less so if he stands near the man who speaks, but on the other side of the door.

The marble pavement of the church is extremely beautiful, seen from this gallery. The paintings on the inner side of the dome, by Sir James Thornhill, are viewed with most advantage here. The ascent to the Ball is attended with some difficulty, and is encountered by few, yet both the Ball and passage to it well deserve the labour. The diameter of the interior of the Ball is six feet two inches, and twelve persons may sit within it.

The prospect from every part of the ascent to the top of St. Paul's, wherever an opening presents itself, is extremely curious. The effect is most complete from the gallery surrounding the foot of the lantern. The metropolis, from that spot, has a mimic appearance, like the objects in a *fantoccino*. The streets, the pavements, the carriages, and foot-passengers, have the appearance of fairy ground and fairy objects. The spectator, contemplating the bustle of the diminutive throng below, is moved a little out of the sphere of his usual sympathy with them; and, as if they were emmets, asks himself involuntarily "about what are those little, inconsequential animals engaged?"

The form of the metropolis, and the adjacent country, is most perfectly seen from the gallery at the foot of the lantern, on a bright summer day. The ascent to this gallery is by 534 steps, of which 260, nearest the bottom, are extremely easy; those above difficult, and in some parts dark and unpleasant. In the ascent to this gallery may be seen the brick cone that supports the lantern, with its ball and cross; the outer dome being turned on the outside of the cone, and the inner dome turned on the inside. The entire contrivance to produce the effect within the church, and on the outside, intended by the architect, is extremely fine, even marvellous. From the pavement of the church, the interior appears one uninterrupted dome to the upper extremity; but it consists, in fact, of two parts, the lower and principal dome having a large circular aperture at its top, through which is seen a small dome, that appears part of the great and lower dome, although entirely separated

from it, being turned also within the cone, but considerably above it.

WESTMINSTER ABBEY.

[*See Plate, No.* 81.]

THIS interesting edifice derives its name of Westminster Abbey from its situation in the western part of the metropolis, and its original destination as the church of a monastery. The present church was built by Henry III. and his successors, with the exception of the two towers at the western entrance, which are the work of Sir Christopher Wren. The length of the church is 360 feet; the breadth of the nave 72 feet; and the cross aisle 195 feet. The roof of the nave and of the cross aisle is supported by two rows of arches, one above the other, each of the pillars of which is a union of one ponderous round pillar, and four of similar form, but extremely slender. These aisles being extremely lofty, and one of the small pillars continued throughout, from the base to the roof, produce an effect uncommonly grand and awful. The choir is one of the most beautiful in Europe. It is divided from the western part of the great aisle by a pair of noble iron gates, and terminates at the east by an elegant altar of white marble. The altar is enclosed with a very fine ballustrade, and in the centre of its floor is a large square of curious *mosaic work*, of porphyry, and other stones of various colours. In this choir, near the altar, is performed the ceremony of crowning the kings and queens of England.

At the southern extremity of the cross aisle are erected monuments to the memory of several of our most eminent poets. This interesting spot is called *Poet's Corner;* and never could place be named with more propriety; for here are to be found the names of Chaucer, Spencer, Shakspeare, Ben Jonson, Milton, Dryden, Butler, Thomson, Gay, Goldsmith, Addison, Johnson, &c.—Here also, as if this spot was dedicated to genius of the highest rank, are the tombs of Handal, Chambers, and Garrick.

The curiosities of Westminster Abbey consist chiefly of its highly-interesting chapels, at the eastern end of the church, with their tombs. Immediately behind the altar stands a chapel dedicated to Edward the Confessor, upon an elevated floor, to which there is a flight of steps on the

northern side. The shrine of the Confessor, which stands in the centre, was erected by Henry III. and was curiously ornamented with mosaic work of coloured stones, which have been picked away in every part within reach. Within the shrine is a chest, containing the ashes of the Confessor. The *frieze* representing his history from his birth to his death, put up in the time of Henry III. is highly curious, and deserves the study and attention of every lover of antiquity. The tomb of Henry III. is in this chapel; it has been extremely splendid, but is now mutilated. The table on which lies the king's effigy in brass is supported by four twisted pillars, enamelled with gilt. This tomb, which is a fine specimen of its kind, is almost entire on the side next the area. It likewise contains the tombs of Edward I. and his Queen Eleanor; of Edward III. and Queen Philippa; of Richard II. and his Queen; of Margaret, daughter of King Edward IV.; of King Henry V.; and of Elizabeth, daughter of King Henry VII.

The grand monument of Henry V. is inclosed by an iron gate. The great arch over the tomb is full of ribs and pannels, and the headless figure of Henry still remains; the head was of solid silver, and was stolen during the civil wars. There was a chantry directly over the tomb, which had an altar-piece of fine carved work. The armour of Henry once hung round this chantry; his helmet yet remains on the bar, and the very saddle which he rode at the battle of Agincourt, stripped of every thing which composed it, except the wood and iron, hangs on the right.

Contigious to the eastern extremity of the church, and opening into it, stands the famous chapel of Henry VII. dedicated to the Virgin Mary, *one of the finest and most highly-finished pieces of Gothic architecture in the world.* On its site formerly stood a chapel, dedicated to the Virgin Mary, and also a tavern, distinguished by the sign of the White Rose. Henry, resolving to erect a superb mausoleum for himself and his family, pulled down the old chapel and tavern; and on the 11th of February, 1503, the first stone of the present edifice was laid by Abbot Islip, at the command of the King. It cost £14,000., a prodigious sum for that period, (equal to £280,000. of our money;) and still more so, considering the parsimonious temper of the King. The labour merely of working the

materials will, at a glance, be seen to be immense, and almost incredible; and the genius employed both in this structure and Henry's tomb, must be mentioned with admiration.

The exterior of this chapel is remarkable for the richness and variety of its form, occasioned chiefly by fourteen towers, in an elegant proportion to the body of the edifice, and projecting in different angles from the outermost wall. It has lately been repaired and renewed with exquisite taste, and at great cost. The inside is approached by the area behind the chapels of Edward the confessor and Henry V.

The floor is elevated above that of the area, and the ascent is by a flight of marble steps. The entrance is ornamented with a beautiful Gothic portico of stone, within which are three large gates of gilt brass, of most curious open workmanship, every pannel being adorned with a rose and a portcullis alternately.

The chapel consists of the nave and two small aisles. The centre is 99 feet in length, 66 in breadth, and 54 in height, and terminates at the east in a curve, having five deep recesses of the same form. The entrance to these recesses being by open arches, they add greatly to the relief and beauty of the building. It is probable they were originally so many smaller chapels, destined to various uses. The side aisles are in a just proportion to the centre; with which they communicate by four arches, turned on Gothic pillars. Each of them is relieved by four recesses, a window running the whole height of each recess, and being most minute and curious in its divisions. The upper part of the nave has its four windows on each side, and ten at the eastern extremity, five above and five below. The entire roof of the chapel, including the side aisles, and the curve at the end, is of wrought stone, in the Gothic style, and of most exquisite beauty.

An altar tomb, erected by Henry, at the cost of £10,000. to receive his last remains, stands in the centre of the chapel. It is of basaltic stone, ornamented with gilt brass, and is surrounded with a magnificent railing of the same. This monument is by Pietro Torregiano, a Florentine sculptor, and possesses uncommon merit. Six devices in bass-relief, and four statues, all of gilt brass, adorn the tomb.

It is impossible to conceive Gothic beauty of a higher

degree than the whole of the interior of Henry the Seventh's Chapel; and it is with regret that the antiquary sees the stalls of the knights reared against the pillars and arches of the nave, forming screens that separate the smaller aisles from the body of the chapel, and diminish the airiness, and interrupt the harmony of the plan.

The prospect from the top of one of the western towers, the ascent to which consists of 283 steps, is infinitely more beautiful, though less extensive, than that from St. Paul's. The many fine situations and open sites at the west end of the town, and its environs, occasion the difference. The Banqueting House at Whitehall, St. James's Park, with the Parade and Horse Guards, Carlton House, the Gardens of the Queen's Palace, the Green Park, the western end of Piccadilly, and Hyde Park, with its river, lie at once under the eye, and compose a most grand and delightful scene. The bridges of Westminster, Waterloo, and Blackfriars, with the broad expanse of water between them, the Adelphi and Somerset House on its banks, St. Paul's stupendous pile, and the light Gothic Steeple of St. Dunstan's in the East, are alike embraced with one glance, and happily contrast with the former prospect. From this tower, the exterior form of St. Paul's, when the sun falls upon it, is distinctly seen: and here its exquisite beauty will be more fully comprehended than in any part of the city, for a sufficient area to take in the entire outline is not there to be found.

THE TOWER OF LONDON.

The Tower of London was anciently a palace inhabited by various sovereigns of England, till the reign of Queen Elizabeth. Its extent within the wall is twelve acres and five roods. The exterior circuit of the ditch, which entirely surrounds it, is 3156 feet. The ditch, on the side of Tower-hill, is broad and deep; on the side next to the river it is narrower. A broad and handsome wharf, or gravel terrace, runs along the banks of the river parallel with the Tower, from which it is divided by the ditch.

Within the walls of the Tower are several streets, and a variety of buildings. The principal buildings are the Church, the White Tower, the Ordnance Office, the Record Office, the Jewel Office, the Horse Armory, the grand

Store House, the small Armory, the Houses belonging to the Officers of the Tower, Barracks for the Garrison, and two Suttling Houses, commonly used by the soldiers of the Garrison.

The White Tower is a large square building, situated in the centre of the fortress. On the top are four watch-towers, one of which, at present, is used as an observatory. It consists within of three lofty stories, beneath which are large commodious vaults. In the first story are two grand rooms, one of which is a small armory for the sea-service, and contains various sorts of arms, curiously laid up, which would serve upwards of ten thousand seamen. In the other rooms, in closets and presses, are abundance of warlike tools and instruments of death. In the upper stories, are arms and armourers' tools. The models of all new-invented engines of destruction, which have been presented to government, are preserved in this tower. On the top is a large cistern filled from the Thames by a water-engine, to supply the garrison with water.

The grand Store House, which stands north of the White Tower, is a plain building of brick and stone, 345 feet long, and 60 feet broad. The Jewel office is a little to the east of the grand Store house. It is a dark and strong stone room. The Horse Armory is a brick building eastward of the White Tower. The Record Office is in the Wakefield Tower, opposite the platform. The rolls from the time of King John to the beginning of the reign of Richard III. are kept here in fifty-six wainscot presses. They contain the ancient tenures of land in England, the original laws and statutes, the rights of England to the dominion of the British seas, the forms of Submission of the Scottish Kings, and a variety of other records, &c.

The principal entrance to the Tower is on the west. It consists of two gates on the outside of the ditch; a stone bridge built over the ditch, and a gate within the ditch.— On the right-hand, at the west entrance, the lions and other wild beast and birds are kept in a yard. The dens are very commodious, and are about twelve feet in their whole height, being divided into an upper and lower apartment. In the former the animals live, and are shown in the day-time; and in the latter they sleep at night. They are in general very healthy; and it is remarkable, that those which

have been whelped in the Tower are more fierce than such as have been taken wild. The dens are inclosed in front by iron gratings: the greater part of them have been recently rebuilt, and every precaution taken to prevent accidents.

The SPANISH ARMORY contains the trophies of the famous victory of Queen Elizabeth over the Spanish Armada. Among these the most remarkable are the *thumb-screws*, intended to be used to extort confession from the English where their money was hidden. In the same room are other curiosities; among which is the axe with which the unfortunate Anne Bullen was beheaded, to gratify the capricious passions of her husband, Henry VIII. A representation of Queen Elizabeth in armour, standing by a cream-coloured horse, attended by a page, is also shewn in this room. Her Majesty is dressed in the armour she wore at the time she addressed her brave army, in the camp of Tilbury, 1588, with a white silk petticoat, ornamented with pearls and spangles.

The SMALL ARMORY is one of the finest rooms of its kind in Europe. It is 345 feet in length, and in general it contains complete stands of arms for no less than 100,000 men. They are disposed in a variety of figures, in a very elegant manner. A piece of ordnance from Egypt has been lately added, sixteen feet long, and seven inches and a half bore. There are several other curiosities, among which are arms taken at various periods from rebels; the highland broad-sword deserves particular notice. In many respects this room may be considered as one of the wonders of the modern world.

The VOLUNTEER ARMORY is in the White Tower, and contains arms, piled in beautiful order, for 30,000 men, with pikes, swords, &c. in immense numbers, arranged in stars and other devices. At the entrance of this room stands a fine figure of *Charles Brandon*, Duke of Suffolk, in bright armour, and having the very lance he used in his life-time, which is eighteen feet long.—The SEA ARMORY is also in this Tower, and contains arms for nearly 50,000 sailors and marines. In this room are two elegant pieces of brass cannon, presented by the City of London to the Earl of Leicester, and various similar curiosities.

Part of the ROYAL TRAIN OF ARTILLERY is kept on the ground floor, under the small armory. The room is

380 feet long, 50 feet wide, and 24 in height. The artillery is ranged on each side, a passage 10 feet in breadth being left in the centre. In this room are 20 pillars that support the small armory above, which are hung round with implements of war, and trophies taken from the enemy. There are many peculiarly fine pieces of cannon to be seen here: one (of brass) is said to have cost £200 in ornamenting. It was made for Prince Henry, eldest son of James I. Others are extremely curious for their antiquity. Among them is one of the first invented cannon. It is formed of bars of iron hammered together, and bound with iron-hoops. It has no carriage, but was moved by six rings, conveniently placed for that purpose.

The HORSE ARMORY is a noble room, crowded with curiosities. The armour of John of Gaunt, Duke of Lancaster, and son of Edward III. is seven feet in height. The sword and lance are of a proportionable size. A complete suit of armour, rough from the hammer, made for Henry VIII. when eighteen years old, is six feet high. The kings of England on Horseback, are shewn in armour from the Conqueror to George II.

The JEWEL OFFICE contains, 1. *The imperial crown*, with which the kings of England are crowned. It is of gold, enriched with diamonds, rubies, emeralds, sapphires, and pearls; within is a cap of purple velvet, lined with white taffety, and turned up with three rows of ermine. This is never used but at coronations, and of course has never been produced since the year 1761.—2. *The golden globe*. This is put into the king's right-hand before he is crowned; and when he is crowned, he bears it in his left-hand, having the sceptre in his right.—3. *The golden sceptre*, and its cross, upon a large amethyst, decorated with table diamonds.—4. *The ancient sceptre*, covered with jewels and Gothic enamel work, and surmounted with an onyx dove. This sceptre is believed to be far the most ancient in the collection, and probably is a part of the original regalia. It was found by the present keeper in 1814, exactly at the time of the general peace. It is estimated at a very high value.—5. *St. Edward's staff*. It is four feet seven inches and a half long, and three inches and three quarters round, made of beaten gold. It is borne before the king in the coronation procession.—6. *The gold salt-seller of state*.

In make it is the model of the square White Tower, and is of excellent workmanship. At the coronation it is placed on the king's table.—7. *The sword of Mercy.* It has no point.—8. *A grand silver font*, used for christenings of the royal family.—9. *The crown of state*, which is worn by the king at his meeting of the parliament, and other state occasions. It is of extreme splendour and value, being covered with large-sized precious stones, and on the top of its cross is a pearl which Charles I. pledged to the Dutch Republic for eighteen thousand pounds. Under the cross is an emerald diamond of a pale green colour, seven inches and a half in circumference, and valued at one hundred thousand pounds; and in the front is a rock ruby, unpolished, in its purely natural state, three inches long, and the value of which cannot be estimated.—10. *The golden eagle*, with which the king is anointed, and the *golden spur*.—11. *The diadem*, worn by the Queens Anne and Mary.—And, 12. *The crown* of Queen Mary, *the cross* of King William, and several other valuable jewels.

In this Office are all the crown jewels worn by the princes and princesses at coronations, and abundance of curious old plate. Independently of several of the jewels which are inestimable, the value of the precious stones and plate contained in this office, is not less than two millions sterling.

The Chapel, situated at the north-end of the parade, is not otherwise attractive than as it contains a few ancient tombs and monuments.

THE BANK OF ENGLAND.

The building thus entitled is an immense and very extensive stone edifice, situated a little to the north-west of Cornhill. The front is composed of a centre, eighty feet in length, of the Ionic order, on a rustic base; and of two wings, ornamented with a colonnade. The back of the building in Lothbury, is a high and heavy wall of stone, with a gate way for carriages into the bullion court.

On the east-side of the principal entrance from Threadneedle-street, is a passage leading to a spacious apartment called the Rotunda, in which business in the public funds is transacted; and, branching out of this apartment, are various offices appropriated to the management of each particular stock. In each of these, under the several letters

of the alphabet, are arranged the books, in which the amount of every individual's interest in such a fund is registered. The hall for the issue and exchange of bank notes is a noble room, seventy-nine feet by forty, and contains a very fine marble statue of King William III., the founder of the bank, an admired piece of sculpture.

The Bank of England covers an extent of several acres, and is completely insulated. Its exterior is not unsuitable to the nature of the establishment, as it conveys the idea of strength and security; but having been erected at different periods, and according to different plans, by several architects, it wants uniformity of design and proportion. In the interior, a variety of alterations and improvements have been made to accommodate the vast increase of business, and of the paper-money and discounting systems. This has required considerable enlargements of the offices in every department, and has led, in the space of twenty-five years, to the necessary increase of the clerks from two hundred to eleven hundred. The capital, or Bank Stock, of this grand national establishment, has also been considerably and progressively augmented: at its incorporation, in 1694, this capital did not exceed £1,200,000.; but has since risen to £14,608,500. The direction is vested in a governor, deputy-governor, and twenty-four directors, elected annually at a general court of proprietors. Thirteen of the directors, with the governor, form a court for the management of the business of the institution.

GENERAL POST-OFFICE.

This collection of buildings, important as its concerns are to the nation, does not claim any praise in an architectural point of view. It stands behind Lombard-street, from which, on the south side, is a passage leading to it, under an arched gateway. It was erected in 1660; but great additions have been made to it from time to time, though the whole is disjointed and inconvenient. A plan has, however, been adopted for erecting a building worthy of this great establishment, on the site now called St. Martin's-le-Grand, and to improve the access to it by pulling down the east ends of Newgate-street and Paternoster-row. It is now proceeding rapidly.

The Post-office system is one of the most perfect regu-

lations of finance and convenience existing under any government. It has gradually been brought to its present perfection, being at first in the hands of individuals, and replete with abuses. In its present form it not only supplies the government with a great revenue, but accomplishes that by means highly beneficial to the persons contributing.

The Post-office is the most important spot on the surface of the globe. It receives information from all countries; it distributes instructions to the antipodes; it connects together more numerous and distant interests of men than any similar establishment. It is, in the highest degree hitherto realized, the seat of terrestrial *perception* and volition,—the brain of the whole earth!

The mode of carrying letters by the general-post was greatly improved a few years since, by a most admirable plan, invented by Mr. Palmer. Previously to its adoption, letters were conveyed by carts, without protection from robbery, and subject to delays. At present they are carried, according to Mr. Palmer's plan, by coaches, distinguished by the name of MAIL-COACHES, provided with a well-armed guard, and forwarded at the rate of eight miles an hour, including stoppages. Government contracts with coach-keepers merely for carrying the *mail*, the coach-owner making a profitable business besides, of carrying passengers and parcels. It is not easy to imagine a combination of different interests to one purpose, more complete than this. The wretched situation, however, of the horses, on account of the length of the stages which they are frequently driven, is a disgrace to the character of the British nation, and requires the interference of the legislature. No stage should exceed twelve miles in length. The rapidity of this mode of conveyance is unequalled in any country.

THE MONUMENT.

ABOUT two hundred yards north of London-bridge, is situated one of the finest pillars in the world, erected by Sir Christopher Wren, in memory of the great fire, which, in 1666, broke out at a house on this spot, and destroyed the metropolis from the Tower to Temple Bar. It is a fluted column of the Doric order; its total height is 202

feet; the diameter at the base is 15 feet; the height of the column 120 feet; and the cone at the top, with its urn, 42 feet. The height of the massy pedestal is 40 feet. Within the column is a flight of 345 steps; and from the iron balcony at the top is a most fascinating prospect of the metropolis and the adjacent country. It is impossible not to lament the obscure situation of this beautiful monument, which, in a proper place, would form one of the most striking objects of the kind that architecture is capable of producing.

The inscription had better be erased, for no rational being can entertain the notion, that the Catholics, or any religious sect, could wilfully have perpetrated so horrible a deed as this pillar was intended to impute to them, nor can so much credit be given to human foresight, as for it to be concluded that a fire, which broke out in a single house, could, upon this, rather than upon other occasions, have extended its ravages in so extraordinary a manner.

THE LOUVRE.

THIS splendid palace, which was planned in the reign of Francis I. at the commencement of the sixteenth century, is a quadrangular edifice, having a court in the centre, and forming a square of 65 French toises, or 416 English feet. The front was built in the reign of Louis XIV. and is one of the most beautiful monuments of his reign. A spacious gallery, 227 toises, or 1450 English feet, in length, connects this palace with that of the Thuilleries. Here was displayed, under the title of THE MUSEE NAPOLEON, that inestimable collection of paintings, one thousand and thirty in number, consisting of the *chefs-d'œuvres* of the great masters of antiquity, and constituting a treasury of human art and genius, far surpassing every other similar institution.

The anti-room leading to the gallery contained several exquisite paintings, the fruits of the triumphs of Bonaparte, or which had been presented to him by the sovereigns who had cultivated his alliance. This apartment was styled by the Parisians the NOSEGAY OF BONAPARTE: its most costly pictures were from the gallery of the Grand Duke of Tuscany; and to these were added a selection from those procured at Venice, Naples, Turin, and Bologna.

It would be impossible adequately to describe the first impressions made on the spectator on his entrance into THE GALLERY, where such a galaxy of genius and art was offered to his contemplation. It was lined by the finest productions of the French, Flemish, and Italian schools, and divided by a curious double painting upon slate, placed on a pedestal in the middle of the room, representing the front and back views of the same figures.

From the Museum the visitor descends into THE SALLE DES ANTIQUES, containing the finest treasures of Grecian and Roman statuary. His notice is instantly attracted by THE BELVIDERE APOLLO, a statue surpassing, in the opinion of connoisseurs, all the others in the collection. This matchless statue is thus described by Sir John Carr, in his work entitled The Stranger in France. "All the divinity of a god beams through this unrivalled perfection of form. It is impossible to impart the impressions which it inspires: the rivetted beholder is ready to exclaim with Adam, when he first discerns the approach of Raphael:

"————————Behold what glorious shape
Comes this way moving: seems another morn
Risen on mid-noon; some great behest from heaven."

"The imaginatian cannot form such an union of grace and strength. One of its many transcendant beauties consist in its aerial appearance and exquisite expression of motion."

THE MEDICEAN VENUS, from the Palace Pitti, at Florence, also formed a part of this magnificent collection of statues. The classic Addison, in speaking of this statue, which he saw at Florence, observes, that it appeared to him much less than life, in consequence of its being in the company of others of a larger size; but that it is, notwithstanding, as large as the ordinary size of women, as he concluded from the measure of the wrist; since, *in a figure of such nice proportions*, from the size of any one part it is easy to guess at that of the others. The fine polish of the marble, communicating to the touch a sensation of fleshy softness, the delicacy of the shape, air, and posture, and the correctness of design, in this celebrated statue, are not to be expressed.

THE PARIS MUSEUM, and SALLE DES ANTIQUES, al-

though deprived, at the termination of the contest with France, of so many *chef-d'-œuvres* of art, still contain others which render them highly interesting. The finest productions of Le Brun, several of them on an immense scale, still remain; as do likewise the matchless marine paintings by Vernet; the truly sublime works of Poussin, consisting of the chief of his masterpieces; together with many choice paintings by Rubens, Wouvermans, De Witte, &c. Many of the statues remaining in the Hall of Antiques are likewise admirable specimens of sculpture.

In the gallery of the Louvre a very curious collection of models, representing the fortresses of France and other countries, was once exhibited; but was removed to the end that the paintings might be seen with greater effect. These models, executed in the reign of Louis XIV. and amounting to upwards of one hundred and eighty, were wrought with the greatest accuracy, and so naturally, as to represent the several cities which they describe, with their streets, houses, squares, and churches, together with the works, moats, bridges, and rivers, not neglecting the adjacent territory, as consisting of plains, mountains, corn-lands, meadows, gardens, woods, &c. Several of these models were so contrived as to be taken in pieces, to the end that the curious observer might be better able to perceive their admirable construction.

THE BRITISH MUSEUM.

This grand national collection of antiquities, books, and natural curiosities, is placed in the noble house formerly belonging to the Duke of Montagu, in Great Russel-street, Bloomsbury. It is a stately edifice, in the French style of the reign of Louis XIV. and on the plan of the Thuilleries. The celebrated French architect, Peter Paget, was sent over from Paris, by Ralph, first Duke of Montagu, expressly to construct this splendid mansion, which is, perhaps, better calculated for its present purpose than for a private residence.

The British Museum was established by act of parliament, in 1753, in consequence of the will of Sir Hans Sloane, who left his museum to the nation, which he declared in his testament, cost him upwards of fifty thousand pounds, on condition that parliament should pay twenty

thousand pounds to his executors, and purchase a house sufficiently commodious for it. The parliament acted with great liberality on this occasion; several other valuable collections were united to this of Sir Hans Sloane, and the whole establishment completed for the sum of eighty-five thousand pounds, which was raised by the way of lottery. Parliament afterwards added, at various times, to the Slonean Museum, the Cottonian Library; that of Major Edwards; the Harleian Collection of Manuscripts; Sir William Hamilton's invaluable collection of Greek Vases; the Townleian collection of Antique Marbles; the Manuscripts of the late Marquis of Lansdown; and, lastly, the celebrated Elgin Marbles, which comprise what are considered as the finest specimens of ancient sculpture.

The whole of the important library of printed books and manuscripts which had been gradually collected by the Kings of England from Henry VIII. to William III. was presented to the Museum by George II.; and George III. bestowed on it a numerous collection of valuable pamphlets, which had been published in the interval between 1640 and 1660. His Majesty likewise contributed the two finest mummies in Europe; the sum of £1,123. arising from lottery prizes, which had belonged to his royal predecessor; and, in 1772, a complete set of the Journals of the Lords and Commons. To these contributions His Majesty has since added a collection of natural and artificial curiosities, sent to him, in 1796, by Mr. Menzies, from the North-West coast of America, and several single books of great value and utility.

The trustees have lately added Greenwood's collection of stuffed birds; Hatchet's minerals; Halhed's oriental manuscripts; Tyssen's collection of Saxon coins; Doctor Bentley's classics; and the Greville collection of minerals. To these may be added numerous donations from several of the Sovereigns of Europe, as well as from learned bodies, and private individuals.

On entering the gate of the Museum, a spacious quadrangle presents itself, with an Ionic colonnade on the south side, and on the north, the main building, which measures 216 feet in length, and 57 in height, to the top of the cornice. Several additional buildings have lately been added for the above collections.

The ground-floor consists of twelve rooms, and contains the library of printed books. The decorations of the staircase have lately been restored, and are worthy of admiration. The ceiling, which represents Phæton petitioning Apollo for permission to drive his chariot, was painted by Charles de la Fosse, who was reckoned one of the best colourists of the French school, and who painted the cupola of the dome of the Invalids at Paris. The landscape and decorations are by James Rousseau, an artist justly admired for his skill in perspective.

The first room on the upper story contains modern works of art from all parts of the world, arranged in cases. In the one in the centre are several beautiful miniatures, among which are those of Sir Thomas More, King Charles I. and Oliver Cromwell, the latter having his watch placed by its side. Two curious portraits of King William III. and Queen Mary, are carved on two walnut-shells. In the presses are arranged, in geographical order, some fine specimens of China, and a variety of implements of war from different quarters of the globe. Here is to be seen the rich collection of curiosities from the South Pacific Ocean, brought by Captain Cooke. In the left corner is the mourning dress of an Otaheitan lady, in which taste and barbarity are singularly blended; and opposite, are the rich cloaks and helmets of feathers from the Sandwich Islands. Among these is one, which, in elegance of form, vies even with the Grecian helmets. In another case are the cava bowls, and above them battoons, and other weapons of war. The next objects of attention are the idols of the different islands, presenting in their hideous rudeness, a singular contrast with many of the works of art, formed by the same people; near these are the drums and other instruments of music, and a breast-plate from the Friendly Islands. The ceiling of this room, or vestibule, represents the fall of Phæton.

The second room consists of similar objects. The third is devoted to the Lansdowne collection of manuscripts, which have been handsomely bound and lettered. In the fourth are the Sloanean and Birchean collections of manuscripts. The fifth contains part of the Harleian library of manuscripts: and the sixth the first part of the same, and additions made since the establishment of the Museum.

The seventh is appropriated to the Royal and Cottonian library of manuscripts. On a table, in a glazed frame, is the original of the Magna Charta, belonging to the Cottonian library. Against the press, No 21, of the Cottonian collection, is the original of the Articles preparatory to the signing of the Great Charter, perfect, with the seal.

The magnificent saloon is filled with the Greville collection of minerals, the finest in the world, admirably arranged, and luminously coloured. The dome of this saloon merits notice. It was painted by La Fosse, and has been described as the apotheosis of Iris, or birth of Minerva.—In the middle of the window stands a table, composed of a variety of lavas from Mount Vesuvius presented by the Earl of Exeter.

The eighth room contains a department of natural history, part of which is the valuable donation of Mr. Cracherode, disposed in two tables, nearly in the Linnæan order; and a much more extensive series, arranged according to the Wernerian system. The principal productions are very valuable, consisting of minerals from Derbyshire, Siberia, the South Seas, volcanic and rock stones from Germany. One very curious specimen of natural history is pointed out in the fifth division of the Cracherodean collection, an egg-shaped piece of calcedony, containing water, (enhydros,) which may be seen by gently shaking the vase. Here also, in a glass-case, is the famous fossil skeleton from Gaudaloupe, which has been the object of much interesting controversy among eminent naturalists in the Monthly Magazine. The ninth is appropriated to petrifactions and shells. In the first division of the cases in the middle of the room is a valuable univalve shell, of the species called the paper nautilus, or argonaut shells, remarkable for the slightness of its fabric, and the elegance of its shape. It is inhabited by an animal not unlike a cuttle-fish, which by extending a pair of membranes, adhering to the top of its longest arms, has the power of sailing on the surface of the sea. Under the tables are deposited, in this and the next room, a great number of volumes and parcels, containing collections of dried plants; which, from the fragile nature of their contents, are shewn only on particular leave. The tenth room is entirely filled with vegetable productions, zoophites, sponges, &c. The contents of the eleventh

room are birds, and arranged, as far as convenience would admit, according to the Linnæan system. Among the curious specimens of ornithology is a humming-bird, scarcely larger than a bee; and another beautiful little creature called the harlequin humming-bird, from the variety of its colours. In this room there is a curious picture, executed many years ago in Holland, of that extremely rare and curious bird, the dodo, belonging to the tribe gallinæ. In the table in the middle are preserved the nests of several birds, among the most curious of which are several hanging nests, chiefly formed by birds of the oriole tribe; nests of a substance resembling isinglass, which the Chinese make into a rich soup; scarce feathers, &c. In the second table are deposited a variety of eggs and nests: among the former may be noticed the eggs of the ostrich, the cassowary, the crocodile, &c. In the cases between the windows are several of the rarer quadrupeds; among these the most curious are, two ourang-outangs, in a young state, a long-tailed macauci, ermine, &c; in cases under the tables are an armadillo, or porcupine, several young sloths, and a fine specimen of the two-toed ant-eater. The twelfth room contains a general and extensive arrangement of fishes, serpents, lizards, frogs, &c.

The Townley Marbles and Egyptian Antiquities, are deposited in a very elegant suite of rooms built purposely for them. The first room is devoted to a collection of bass-reliefs, in terra cotta, pronounced the finest in Europe. The second is a beautiful circular room, whence you have a fine view of the whole suite of apartments, bounded at the end by an exquisitely-wrought *discobolon*, or ancient quoit-player. This room is devoted to Greek and Roman sculptures, among which may be pointed out a fine candelabrum, with several beautiful busts and statues. The third and fourth rooms are also filled with Greek and Roman sculptures: in the latter are several fine bass-reliefs. The fifth contains a collection of Roman sepulchral monuments, and a beautiful mosaic pavement, recently discovered in digging the foundations for the new building at the bank of England. The sixth exhibits a miscellaneous collection of one hundred grand pieces of Roman and Greek sculpture. The seventh is devoted to Roman antiquities; and the eighth, on the left, to Egyptian antiquities, among which are the two

mummies before mentioned, with their coffins; a manuscript, or papyrus, taken from a mummy, &c. Among the Egyptian sculptures in the ninth room, is the celebrated sarcophagus, commonly called the tomb of Alexander the Great,—[*See Plate, No.* 73.]—an engraving and dissertation on which appeared in the Monthly Magazine for February, 1809. The tenth contains Greek and Roman sculptures of singular beauty.

Thence returning, and proceeding up stairs, the visitor is conducted to the eleventh room, containing ancient and modern coins and medals, arranged in geographical order, those of each country being kept separate. It is not shown unless by the permission of the trustees, or of the principal librarian. Not more than two persons are admitted at one time, without the presence of the principal librarian, or of some other officer. The twelfth room contains the collection of the late Sir William Hamilton, which has been removed from the saloon. It principally consists of penates, or household goods, bronze vessels, utensils, &c. specimens of ancient glass, necklaces, bullæ, fragments of relievos, and ancient armour, tripods, knives, patent lamps, seals, weights, sculpture in ivory, bracelets, bits, spurs, ancient paintings from Herculaneum, Babylonish bricks, and his unrivalled collection of Greek vases, the greater part of which were found in the sepulchres of Magna Grecia. The forms of the vases are much varied, and are equally simple and beautiful. In the thirteenth is deposited the extensive and valuable collection of prints and drawings, the most important part of which was bequeathed by the Rev. William Cracherode. The contents of this room can be seen only by a few persons at a time, by particular permission.

THE LINWOOD GALLERY, LEICESTER-SQUARE.

In viewing the beautiful specimens of female ingenuity displayed in this gallery, the mind naturally reverts to the best days of the Gobelin tapestry; and it is not paying any compliment to Miss Linwood to say, that as works of art, for truth and fidelity of colouring, expression and outline, they need not shun a comparison with the finest of the French performances. Considering them in another point of view, AS PRODUCTIONS OF THE NEEDLE, they are the most wonderful performances on record, and have opened

a new and beautiful road for the amusement of our females of every rank. Too much praise cannot, therefore, be bestowed on this lady for her invention of a new style of picturing " A Michael's grandeur and a Raphael's grace."

The exhibition consists of about seventy exquisite copies, in needle-work, of the finest pictures of the English and Foreign schools, possessing all the correct drawing, just colouring, light and shade, of the original pictures from which they are taken, and to which in point of effect, they are in no degree inferior. On entering the door from Leicester-square, the visitor is shown into the principal room, a fine gallery of excellent proportions, hung with scarlet broadcloth, gold bullion tassels, and Greek borders. On one side of this room the pictures are hung, and have a guard in front to keep the company at the requisite distance, and for preserving them. In the piers and windows are sofas and settees, to match the hangings of the room, for the accommodation of the visitors; and at the upper-end a splendid seat and canopy of satin and silver. Turning to the left, through the door near the canopy, a long and obscure passage prepares the mind, and leads to the cell of a prison, on looking into which is seen the beautiful Lady Jane Gray, visited by the abbot and keeper of the tower, the night before her execution. The scenic deception of the whole is most beautiful. A little farther on is a cottage, the casement of which opens, and the hatch of the door is closed; on looking in at either, is seen a fine and exquisitely-finished copy of Gainsborough's cottage children, standing by the fire, with chimney-piece and cottage furniture complete. Near to this is Gainsborough's woodman, exhibited in the same scenic manner; and a little farther is a den with lionesses. Returning back into the gallery on the window side, the visitor finds a tasteful room, which is properly devoted to a single picture, Christ blessing the sacramental bread and wine, after Carlo Dolci; and this is without doubt, the most valuable copy of that fine original in existence, independently of its value being increased as the work of Miss Linwood.

BULLOCK'S MUSEUM, PICCADILLY.

THIS collection may be reckoned one of the most complete of its kind, and contains upwards of ten thousand dif-

ferent objects, including quadrupeds, birds, reptiles, insects, ancient arms, works of art, &c. arranged in scientific order.

The South Sea Curiosities were principally brought to England by Captain Cook, and consist of superb feathers, cloaks, helmets, hats of feathers, ornaments, breastplates, war-clubs, idols, fish-hooks, fly-flaps, caps, &c. To these are added, from other sources, war-clubs, paddles, bows, rattles, adzes and axes of hard black stone, knives, dresses, &c. Among the North and South American Curiosities are maucasons, or shoes; a quiver with poisoned arrows, and a tube for discharging them; belts; pouches; a great variety of bows and arrows; snow shoes; the calumet, or pipe of peace; a wampum belt; a specimen of cloth, made of the asbestos, &c. brought from Canada, Hudson's Bay, and other parts of these territories. The class of African Curiosities contains musical instruments; sceptres; pouches; shoes; fans; bows; poisoned arrows; lances; daggers, &c. with hammocks; gourds; an African harp; a pair of bellows; and other curious objects.

The department of Works of Art, contains, among other objects of great value and beauty, a fine equestrian model of Edward the Black Prince, in armour; models in coloured wax; busts in rice paste; medals of ancient armory, of a Chinese pagoda, and of men of war, in coloured straw; sculptures in ivory; pictures, in coloured sand, in wood, &c.

The department of Natural History contains several thousand species, and excels any in Great Britain, either for the rarity and number of the specimens, or the beautiful and novel manner in which they are displayed. Among the quadrupeds are all the interesting specimens, from the huge elephant and the rhinoceros to the most minute species. The giroffe, or camelopardalis, seventeen feet three inches high, is the finest in Europe. Among the birds, are beautiful specimens of the bird of Paradise; that magnificent bird the grand hoopoe; humming birds; a black swan; an undescribed water-bird, of the duck tribe, &c. &c. all beautifully stuffed. Among the amphibious animals is the great boa, thirty-two feet in length; the American and African iguana serpents; rattlesnakes; spectacle snakes; a fine specimen of the geometrical tortoise, &c. The Icthyological, Entomological, and Mineralogical departments are equally rich; as is likewise that of the marine productions.

The miscellaneous articles are numerous, and skilfully selected.

The Armory of the Museum is fitted up in an appropriate and elegant manner, representing the interior of the hall of one of the castles of our ancient nobility: the armour and various instruments of war are displayed in trophies, or on figures, placed under gothic canopies.

Neither pains nor expence have been spared by Mr. Bullock to enrich his museum. The travelling carriage of Bonaparte,—the economy of space in which is like that of the cells of a bee-hive,—was purchased by him of Lord Bathurst for 3000 guineas. It was estimated that, up to the month of June, 1817, either at the museum, or in several great towns of the empire, where it has been exhibited, not less than *four hundred thousand persons* had entered this very interesting vehicle. To this he has added a curious and costly assemblage of imperial relics from the palaces of Napoleon the Great; two splendid mosaic pavements, recently found on the floors of the baths of Nero; two specimens of the transcendant skill of Canova, displayed in the figures of Hebe and Terpsichore, so admirably sculptured, that they seem to move and breathe, &c.

DOCTOR HERSCHEL'S GRAND TELESCOPE.

[*See Plate, No.* 85.]

To lead to a clearer comprehension of the principle on which the telescopes of Dr. Herschel are constructed, it is necessary to advert to those of Newton and Gregory. The former of these consists of a tube, towards the end of which a concave mirror is placed. The converging rays, before they reach the focus, are made to fall on a plane mirror placed at an angle of forty-five degrees, and thrown upward to the focus of a convex lens, fixed in the upper side of the telescope, through which the eye looks down on the object. The latter consists of a tube, on which a concave mirror, having a hole in its centre, is placed. Any parallel rays from an object falling on this mirror, will, after reflection, form an inverted image at its focus. This image, however, is intercepted by a smaller mirror, which reflects it back to an eye-glass in the hole of the large mirror, through which the observer views the object.

In the telescopes made by Dr. Herschel, the object is

reflected by a mirror, as in the Gregorian telescope, and the rays are intercepted by a lens at a proper distance, so that the observer has his back to the object, and looks through the lens at the mirror. The magnifying power is the same as in the Newtonian telescope; but there not being any second reflector, the brightness of the object viewed in the Herschel telescope is greater than that in the Newtonian telescope.

The tube of DOCTOR HERSCHEL'S GRAND TELESCOPE is 39 feet 4 inches in length, and 4 feet 10 inches in diameter, every part being made of iron. The concave polished surface of the great mirror is 4 feet in diameter, its thickness 3½ inches, and its weight upwards of 2000lbs. This noble instrument was, in all its parts, constructed under the sole direction of Doctor Herschel: it was begun in the year 1785, and completed August 28th, 1789, on which day was discovered the sixth satellite of Saturn. It magnifies *six thousand times.*

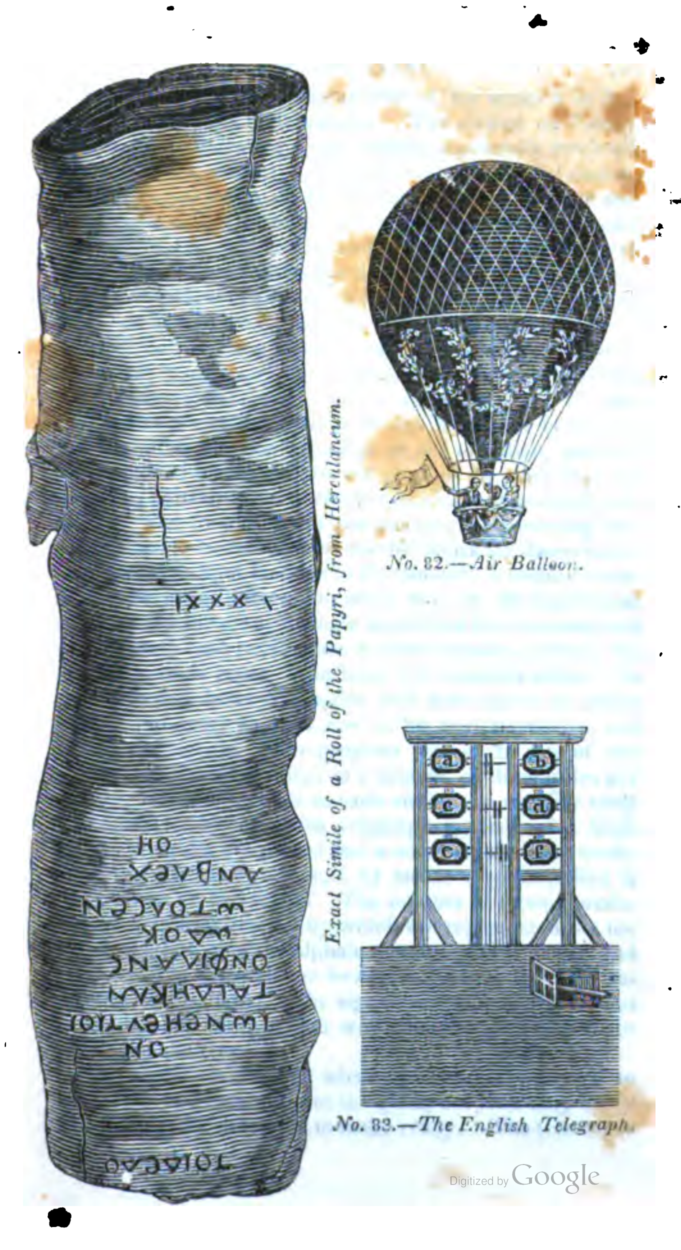
Illustration of the cut. A B C is a ray of light, reflected by the great speculum B to the eye-glass. C D is a chair for the observer. E, a moveable gallery for spectators. F G, a smooth base for the frame to turn on. H and I, pullies to move the instrument. K are rooms for assistants.

THE ENGLISH TELEGRAPH.

[*See Plate, No.* 83.]

BETWEEN London and Portsmouth there are 12 stations; and thirty-one between London and Plymouth, of which eight are part of the Portsmouth line till they separate in the New Forest. Another chain, extending from London to Yarmouth, contains nineteen stations; and another from London to Deal, ten stations; making in the whole system sixty-four telegraphs. The distances average about eight miles, yet some of them extend to twelve or fourteen; and the lines are often increased by circuits, for want of commanding heights. In the Yarmouth line particularly, the chain makes a considerable detour to the northward.

After about twenty years' experience, they calculate on about two hundred days on which signals can be transmitted throughout the day; about sixty others on which they can pass only part of the day, or at particular stations; and about one hundred days in which few of the stations are



Exact Simile of a Roll of the Papyri, from Herculaneum.

No. 32.—Air Balloon.

No. 33.—The English Telegraph.

visible to the others. The powers of the stations in this respect are exceedingly various. The station on Putney Heath, communicating with Chelsea, is generally rendered useless during easterly winds by the smoke of London, which fills the valley of the Thames between this spot and Chelsea hospital; or more commonly between the shorter distance of the Admirality and Chelsea. Dead flats are found to be universally unfavourable; and generally stations are useless nearly in the proportion of the miles of dead flat looked over. On the contrary, stations between hill and hill, looking across a valley, or series of valleys, are mostly clear; and water surfaces are found to produce fewer obscure days than land in any situation. The period least favourable of the same day is an hour or two before and after the sun's passage of the meridian, particularly on dead levels, where the play of the sun's rays on the rising exhalations renders distant vision exceedingly obscure. The tranquility of the morning and evening are ascertained to be the most favourable hours for observation.

A message from London to Portsmouth, is usually transmitted in about fifteen minutes; but, by an experiment tried for the purpose, a single signal has been transmitted to Plymouth and back again *in three minutes*, which, by the Telegraph route, is at least five hundred miles. In this instance, however, notice had been given to make ready, and every captain was at his post to receive and return the signals. The progress was at the rate of one hundred and seventy miles in a minute, or three miles per second, or three seconds at each station; a rapidity truly wonderful! The English telegraph consists of a large frame, in which are placed and worked six shutters, marked in the plate a, b, c, d, e, f, by means of ropes pulled in the manner of bell ropes. The number of signals produced by it is sixty-three—by which are represented the ten digits, the letters of the alphabet, many generic words, and all the numbers which can be expressed by sixty-three variations of the digits. The signals are sufficiently various to express any three or four words in twice as many changes of the shutters.

The observers at these telegraphs are not expected to keep their eye constantly at the glass, but look only every five minutes for the signal to make ready. The telescopes

are Dolland's Achromatics, which possess no recommendation but their enlarged field, and their freedom from prismatic colours in that field; points of no consequence in looking through a fixed glass at a fixed and circumscribed object. The field of the Galilean telescope is quite large enough, and having, instead of the six contained in Dollond's achromatics, but two lenses, one of which is a thin concave, it exhibits the object with greater brightness, and therefore ought to have been preferred for this purpose. It seems strange also, that, to ease the operator, it has never been contrived to exhibit the fixed spectrum, on the principle of a portable camera, so that, without wearying the eye, the changes of the distant telegraph might have been exhibited on a plane surface, and seen with both eyes.

THE AIR BALLOON.

[*See Plate, No.* 82.]

Among the many discoveries of modern philosophy this is one of the most splendid: hitherto, however, it has not been attended by corresponding utility, owing to the difficulty of steering the machine. The most promising attempts to overcome this difficulty were made by Zembeccari, an Italian, whose aerial excursions are curiously detailed by Kotzebue, in his travels, and whose principles were truly scientific; but still this great desideratum remains to be attained.

The discovery of hydrogen gas, which is 15 times lighter than atmospheric air, suggested the plan of filling with this gaseous substance a silken balloon, and of its ascent in the air, with an aeronaut appended to it, provided the whole should not exceed the weight of an equal bulk of atmospheric air. The process of filling the balloon is accomplished by mixing five parts of water with one of sulphuric acid, and pouring the mixture on iron filings: the light gas, by the decomposition of the water, will rise into the balloon; and the balloon, being 12 times lighter than the atmospheric air, will rise through it. Thus have two, three, and even four persons, been at one time carried through the atmosphere.

More than fifty aerial voyages, in different parts of Europe, have been made by Blanchard; nearly as many by Garnerin; and thirty by Mr. Sadler.

THE STEAM ENGINE.

[*See Plate, No.* 83.]

THIS engine consists of a large cylinder or barrel, in which is fitted a solid piston like that of the forcing pump. Steam is thus supplied from a large boiler, which in forcing up the piston, instantly opens a valve, through which cold water rushes on the principle of the common pump. Other steam is then introduced, which forces it down again, and drives the water out of the pipe with immense force. The steam then raises the piston again, and again makes it fall by which alternate motion the grandest operations are performed. The action of the piston moves up and down a large beam; and this beam communicates to other machinery the power of 100 or 200 horses.

The power of some of the steam engines constructed by Messrs. Boulton and Watt, is thus described, as taken by actual experiment. An engine, having a cylinder of 31 inches in diameter, and making 17 double strokes per minute, performs the work of 40 horses, working night and day, (for which three relays, or 120 horses. must be kept) and burns 11,000 pounds of Staffordshire coal per day.— A cylinder of 19 inches, making 25 strokes of 4 feet each per minute, performs the work of 12 horses, constantly labouring, and burns 3,700 pounds of coals per day.— These engines will raise more than 20,000 cubic feet of water, 24 feet high, for every hundred weight of good pit coal consumed by them.

The principal of Watt's improved engine, represented in the cut, is the same as the above, but the economy is still greater. The steam which is below the piston escapes into the condenser A, by the cock B, which is opened by the rod C, and at the same time the steam is admitted by the cock D into the upper part of the cylinder: when the piston has descended, the cocks E and F act in a similar manner in letting out the steam from above, and admitting it below the piston. The jet is supplied by the water of the cistern G, which is pumped up at H, from a reservoir: it is drawn out, together with the air which is extricated from it, by the air pump I, which throws it into the cistern K, whence the pump L raises it to the cistern M, and it enters

the boiler through a valve which opens whenever the float W descends below its proper place. The pipes O and P serve also to ascertain the quantity of water in the boiler. The piston rod is confined to a motion nearly rectilinear, by the frame Q. The fly-wheel R is turned by the sun and planet wheel S T, and the strap U turns the centrifugal regulator W, which governs the supply of steam by the valve or stop cock X.

STEAM BOATS.

[*See Plate, No.* 86.]

THE description of the Clyde steam boat, represented in the plate, is as follows. Its extreme length is 75 feet, its breadth 14, and the height of the cabins 6½ feet. She is built very flat, and draws from 2 feet 9 inches to 3 feet water. The best or after-cabin, is 20 feet long, and is entered from the stern: between the after-cabin and the engine a space of 15 feet is allotted for goods. The engine is a 12 horse power, and occupies 15 feet: the fore-cabin is 16 feet long, and is entered from the side. The paddles 16 in number, form two wheels of 9 feet diameter, and 4 feet broad, made of hammered iron: they dip into the water from 1 foot 3 to 1 foot six inches. Along the outer edge of these wheels a platform and rail are formed quite round the vessel, projecting over the sides, and supported by timbers reaching down to the vessel's side. This steam boat runs at the rate of 4 or 4½ miles per hour in calm weather; but against a considerable breeze 3 miles only. It can accommodate 250 passengers, and is wrought by five men. The engine consumes 12 cwt. of coals per day. The funnel of the boiler is 25 feet high; and carries a square sail 22 feet in breadth.

To convey a precise idea of the utility of steam boats, and to quiet the apprehensions entertained relative to their safety, the following details, by Sir Richard Phillips, have appeared in the Monthly Magazine.

The groundless alarms relative to a supposed increase of danger from travelling by Steam-packets, led the editor of the Monthly Magazine, within the current month, (July, 1817) to make a voyage in one of them from London to Margate. This vessel left her moorings, at the Tower of London, about half past eight in the morning, at the time

the tide was running strong up the river, and when no other vessel could make progress, except in the direction of the tides. The steam-packet proceeded, however, against the stream, in a gallant style, at the rate of six or seven miles an hour; and a band of music, playing lively airs on the deck, combined with the steadiness of the motion, to render the effect delightful. An examination of the steam engine, and of her rate of working, proved that no possibility of danger exists. It appeared that the boiler had been proved at twenty-five pounds to the square inch; but that the valve was held down by a weight of only four pounds, and that the mercurial gauge did not indicate an employment of actual pressure of above two pounds and a half per square inch. Hence it follows, that, although the engine was capable of sustaining a pressure of at least twenty-five pounds, only four pounds, or less than a sixth, was the whole force which the valve would permit to be exerted; and that, in point of fact, a pressure of only two pounds and a half to the square inch, or only *one tenth* of the proven power of the boiler, was employed. There is, therefore, less danger in passing some hours in contact with such a machine, than there is in sitting near a boiling tea-kettle, tea-urn, or saucepan, under circumstances in which they are often used. Opposite Greenwich a fine commentary was afforded of the value of steam as a navigating power, in preference to winds and tides, a Margate sailing-packet passing towards London, which had been a day and two nights on its passage, a period of time which it appears is not uncommon. In short, with uninterrupted pleasure, and in an hour sooner than the captain had named at starting, the vessel was carried along-side Margate-pier, having employed nine hours in performing a voyage of ninety miles. In this case it appeared, that a pressure of two pounds to the square inch produced about forty rotations per minute of the acting water wheels; and, as these were ten feet in diameter, the motion of the impelling floats, or wheel-paddles, would be at the rate of fifteen with or against the stream, at an average of ten miles an hour. The consumption of coals during the voyage was less than a chaldron; but it was described as amounting frequently to a chaldron and a half On the whole, nothing could be more demonstrative of the worth and security of

this mode of navigation; and there can be little doubt but, in a few years, vessels of every size, and for every extent of voyage, will be provided with their steam-engine, which will be more used, and more depended upon, than winds or tides. The chances of accidents are lower than those under most other circumstances in which men are placed in travelling. By land, horses kill their thousands per annum, open chaises their hundreds, and stage-coaches their scores; and, by water, the uncertainty of winds has destroyed thousands, by prolonging the voyage, and increasing the exposure to bad weather; but in a steam-packet, navigated by an engine whose proven powers necessarily exceed what can be exerted during its use, or in general by such engines as those used on the Thames or Clyde, no accident can possibly happen—unless, by a miracle, it were to happen, that a force of *four* pounds should overcome a resistance of *twenty-four* pounds.

THE LIFE-BOAT.

The principle of this wonderful boat appears to have been suggested to the inventor, Mr. Greathead, by the following simple fact: that if a spheroid be divided into quarters, each quarter is elliptical, and nearly resembles the half of a wooden bowl, having a curvature with projecting ends; and that this quarter being thrown into the sea, or agitated water, cannot be upset, or be made to lie with the bottom upwards.

The length of the boat is thirty feet, and the breadth ten feet; the depth from the top of the gunwale to the lower part of the keel is three feet three inches; from the gunwale to the platform (within) two feet four inches; from the top of the stems (both ends being similar) to the horizontal line of the bottom of the keel five feet nine inches. The keel is a plank of three inches thick, of a proportionate breadth in midships, narrowing gradually towards the ends to the breadth of the stems at the bottom, and forming a great convexity downwards. The ends of the bottom section form that fine kind of entrance observable in the lower part of the bow of the fishing-boat called a coble, much used in the north. From this part to the top of the stem it is more elliptical, forming a considerable projection. The sides from the floorheads to the top of the gunwale flaunch

off on each side in proportion to above half the breadth of the floor. The breadth is continued far forwards towards the ends, leaving a sufficient length of straight side at the top. The sheer is regular along the straight side, and more elevated towards the ends; the gunwale fixed to the outside is three inches thick, and cased with layers of cork to the depth of sixteen inches downwards. The cork on the outside is secured with thin plates or slips of copper, and the boat is fastened with copper nails. The thwarts, or seats, are five in number, double banked, consequently the boat may be rowed with ten oars. The boat is steered with an oar at each end, and the steering-oar is one-third longer than the rowing-oar. The platform, placed at the bottom within the boat, is horizontal, the length of the midships, and elevated at the ends for the convenience of the steersman, to give him a greater power with the oar. The internal part of the boat next the sides is cased with cork, the whole quantity of which affixed to the life-boat is nearly seven hundred weight. The cork contributes much to the buoyancy of the boat, and is a good defence in going along-side a vessel; but its principal use is in keeping the boat in an erect position in the sea; or, rather, for giving her a very lively and quick disposition to recover from any sudden cant or lurch, which she may receive from the stroke of a heavy wave.

The ends being similar, the boat can be rowed either way; and this peculiarity of form alleviates her in rising over the waves. The curvature of the keel and bottom facilitates her movement in turning, and contributes to the ease of the steering, and a single stroke of the steering-oar has an immediate effect, the boat moving, as it were, upon a centre. The fine entrance below is of use in dividing the waves when rowing against them; and, combined with the convexity of the bottom, and the elliptical form of the stem, admits her to rise with wonderful buoyancy in a high sea, and to launch forward with rapidity, without shipping any water, when a common boat would be in danger of being filled. The internal shallowness of the boat from the gunwale down to the platform, the convexity of the form, and the bulk of cork within, leave a very diminished space for the water to occupy; so that the life-boat, when filled with water, contains a considerable less quantity than the

common boat, and is in no danger either of sinking or overturning, whatever be the violence of the winds or waves.

The first of these boats went off on the 30th of January, 1790, and it has so well answered every expectation in the most tremendous seas, that, during the last twenty-five years, between four and five hundred lives have been saved at the entrance of the Tyne alone, which otherwise must have been lost, and in no instance has it ever failed. Of course, every ship and every port ought to be provided with its life-boat.

FIRST-RATE MAN OF WAR.

Of all the arts and professions which are calculated to attract a particular notice, no one appears more astonishing and marvellous than that of navigation, in the state in which it at presents exists. This cannot be made more evident, than by taking a retrospective view of the small craft to which navigation owes its origin, and comparing them to A MAJESTIC FIRST-RATE MAN OF WAR, containing one thousand men, with their provision, drink, furniture, apparel, and other necessaries, for many months, besides one hundred pieces of heavy ordnance, and bearing all this heavy apparatus safely to the most distant shores. A man in health consumes, in the space of twenty-four hours, about eight pounds of victuals and drink: consequently eight thousand pounds of provisions are daily requisite in such a ship. Let her be supposed, then, to be fitted out for three months, and it will be found, that she must be laden with 720,000 pounds of provisions. A large forty-two pounder, if made of brass, weighs about [illegible], and about 5,500, if of iron; and, in general, there are twenty-eight or thirty of these on the lower gun-deck, on board a ship of 100 guns; the weight of these, exclusive of that of their carriages, amounts to 183,000 pounds. On the middle gun-deck are thirty twenty-four-pounders, each weighing about 5,100 pounds, and, therefore, collectively, 153,000 pounds; and the weight of the twenty-six or twenty-eight twelve-pounders on the upper gun-deck, amounts to about 75,400 pounds; that of the fourteen six-pouuders on the quarter-deck, forecastle, and poop, to about 26,000 pounds; and, besides these, there are, in the round-tops, even three-pounders and swivels. If to this be added, that the com-

plete charge of a forty-two pounder weighs about sixty-four pounds; and that at least 100 charges are required for each gun, this will be found to amount nearly to the same weight as the guns themselves. In addition also to this, the reflection must be made, that every ship must have, to provide against exigencies, at least another set of sails, cables, cordage, and tackling, which, taken together, amount to a considerable weight: the stores likewise consisting of planks, pitch, and tow; the chests belonging to the officers and seamen; the surgeon's stores; and various other articles requisite on a long voyage; with the small arms, bayonets, swords, and pistols, make no inconsiderable load. To this must be finally added, the weight of the crew; so that one of these first-rates carries, at the least, 2,162 tons burden, or 4,324,000 pounds; and, at the the same time, is steered and governed with as much ease as the smallest boat.

PRINTING ENGINE.

A NEW PRINTING PRESS, OF PRINTING ENGINE has recently excited the attention of the typographical world. It is wrought by the power of steam, and, with the aid of three boys, perfects nearly a thousand sheets per hour. A common press, worked by two men, takes off but two hundred and fifty impressions on one side, and requires eight hours to *perfect* a thousand sheets. Hence, three boys in one hour are enabled, by this new application of the power of steam, to perform the labour of two men for eight hours. Such are the present capabilities of this engine: but as there is no limit to its required powers, and the size of the *form* is no obstacle to its perfect performance, it is proposed to take impressions on double-demy, in which case three boys will, in one hour, perform the labour of thirty-two men. This engine is now at work at the printing-office of Bensley and Sons, near Fleet street, and another on a similar, but less perfect, construction, has for some time past been employed on a Morning Newspaper. In its general analogy, this press is not unlike the rolling-press of copper-plate printers. The forms being fixed on the *carriage*, are drawn under a cylinder, on which the sheet being laid, and the ink distributed by an arrangement of rollers, the impression is taken on one side. The sheet is then conveyed off by bands to a second cylinder, around

which it is conveyed on the *second form*, and the *reiteration* is produced in *perfect register*, without the aid of *points*. All the manual labour is performed by a boy, who lays the sheet of paper on the first cylinder, by one who takes it off from the second cylinder, and by a third, who lays the sheets even on the *bank*. As a farther instance of economy in the materials, we may mention, that the waste steam from the copper is carried in tubes round the entire suite of offices, with a view to warm them.

GRAND GALVANIC BATTERY.

To comprehend more precisely the astonishing powers of this battery, prepared by Sir Humphrey Davy for the laboratory of the Royal Institution, it is necessary *to premise*, that the conductors of the galvanic fluid are divided into *perfect* and *imperfect*, the former consisting of metallic substances and charcoal, and the latter of water and oxydated fluids, as the acids and all the substances which contain these fluids. The simplest galvanic combinations must consist of three different conductors, not wholly of one class. When two of the three bodies are of the first class, the combination is said to be of the first order; when otherwise, it is said to be of the second. In simple galvanic circles it is indispensibly requisite that the conductors of one class shall have some chemical action on those of the other; for example: if a piece of zinc be laid on a piece of copper, and on the copper a piece of card or flannel, moistened with a solution of salt-water, a circle of the first class is formed; and if three other pieces be then laid on these in the same order, and repeated several times, the whole will form a pile, or battery, of the first order. When the three bodies which form a galvanic circle of the first order are laid on each other, the upper and the under ones not touching, these two extremes are in opposite electric states. The galvanic effects may be increased to any degree, by a repetition of the same simple galvanic combination; and these repeated combinations are called galvanic piles, or batteries, which may be constructed of various forms.

THE GRAND GALVANIC BATTERY, the most powerful combination existing, consists of two hundred separate troughs of Porcelain, connected together in regular order, each being composed of ten double plates, arranged in cells, and

containing in each plate 32 square inches; so that the whole number of double plates is 2000, and the whole surface 128,000 square inches. This battery, when the cells are filled with sixty parts of water, mixed with one part of nitric acid, and one part of sulphuric acid, afford a series of brilliant and impressive effects. When pieces of charcoal, about an inch in length, and one sixth of an inch in diameter, are brought near each other (within the thirtieth or fortieth part of an inch) a bright spark is produced, and more than half the volume of the charcoal becomes ignited to whiteness; and, by withdrawing the points from each other, a constant discharge takes place through the heated air, in a space equal at least to four inches, producing a most brilliant ascending arch of light, broad, and conical in form in the middle. When any substance is introduced into this arch, it instantly becomes ignited; platina melts as readily in it as wax in the flame of a common candle; quartz, the sapphire, magnesia, lime, all enter into fusion: fragments of diamond and points of charcoal and plumbago, rapidly disappear, and seem to evaporate in it. Such are the decomposing powers of electricity, that not even insoluble compounds are capable of resisting their energy: for glass, sulphate of baryta, fluor spar, &c. when moistened and placed in contact with electrified surfaces from the voltaic apparatus, are slowly acted on, and the alkaline, earthy, or acid matter carried to the poles in the common order. Not even the most solid aggregates, nor the firmest compounds, are capable of resisting this mode of attack; its operation is slow; but the results are certain; and sooner or later, by means of it, bodies are resolved into simpler forms of matter.

THE BLOW-PIPE.

[*See Plate, No.* 84.]

By the blow-pipe every effect of the most violent heat of furnaces may be produced, by the flame of a candle or lamp, urged upon a small particle of any substance. This instrument consists merely of a brass pipe about one-eighth of an inch in diameter at one end, and the other tapering to a much less size, with a very small perforation for the wind to escape. The smaller end is bent on one side. For philosophical or other nice purposes the blow-pipe is provided with a bowl or enlargement, in which the vapours of the

breath are condensed and detained, and also with three or four small nozzles, with different apertures, to be slipped on the smaller extremity.

The results of the philosophical experiments made with this instrument are beautiful and truly surprising; but some precautions are required. In describing the blow-pipe invented by him, Mr. Newton remarks that it has been very generally used to obtain a high temperature, by THE COMBUSTION OF OXYGEN AND HYDROGEN GASES. The mode of rendering this instrument safe, was by rejecting all jets but such as were of a very fine bore; and as any inflammation of gases may be arrested in its passage by an aperture sufficiently minute, all danger of the return of the flame was thus obviated. A desire, however, to increase the heat, has occasiouly led to the use of tubes through which the flame could recede, and an explosion has consequently happened to apparatus, to the destruction of the instrument, and the danger of the experimentalist.

Doctor Clarke, professor of mineralogy in the University of Cambridge, observes on this head, that the experiments should be made with tubes, whose diameters are, at the least, equal to 6–60th of an inch, because the heat is thus rendered incomparably greater: but, as the danger is also greater, it is necessary to devise some expedient, by which, making allowance for the probability of an explosion, the operator may be protected from injury. His contrivance to afford him perfect security, whatever explosion may happen, consists merely of a screen, made of deal planks, about 1½ inch thick, and reaching about 12 feet from the floor of the laboratory, so constructed that the one half opens like a door, the other half remaining fixed. The blow-pipe is placed behind the half that is fixed; and a small hole is bored through this half, barely large enough to allow the jet and stop-cock to pass through.

The instrument, thus secured, is represented in the plate. A B is the deal screen in two parts; A being made to open, and B a fixture,—before the window C. D represents the gaseous reservoir of the blow-pipe. E, the bladder containing the gaseous mixture for compression. F, the hand of the operator upon the stop-cock of the jet, on the outside of the screen. G H, a tube of glass, or of brass, for the jet. And I, the spirit lamp for igniting the gas.

Among the many very curious experiments made with the blow-pipe by Dr. Clarke, the following may be adduced as examples. Several oriental rubies being placed on charcoal, their fusion was so rapid that he feared they would volatilize. They ran together into a bead, and remained in such a liquid state before the gas, that the current of it penetrated like a stream of air upon oil, when urged by a pair of bellows. The bead, when examined, was white and opaque; all colour having disappeared. Being again exposed to the ignited gas, and taken from the charcoal by iron forceps, its surface was covered by a thin flaky metallic substance, which came off on the fingers, glittering like scales of carburet of manganese. On being fused a third time, it assumed a variety of shapes, like sapphire during fusion. The reduction of the oxide of tin afforded an easy and very beautiful experiment. Wood-tin, exposed to the ignited gas, communicated a beautiful blue colour, like that of violets, to the flame. In employing a pair of iron forceps, as a support, the iron became covered with an oxide of tin of incomparable whiteness. The fusion was rapid; and when the wood-tin was placed on charcoal, the metal was revived in a pure and malleable state.—In effecting the fusion and combustion of platinum, the largest drops which fell from the melting of platinum wire, when exposed to the utmost heat, weighed ten grains; but drops of metal weighing fourteen grains were obtained when the [illegible] of gas [illegible] so as not to let the metal run off too quickly from the wire. By placing several globules on a piece of charcoal, and suffering the whole force of the gas to act upon them, the metal was made to boil, and they all ran together into one mass.

THE SAFETY LAMP.

The invention of the wire-gauze-safe-lamp, for preventing explosions from fire damp, and for giving light in explosive atmospheres, is due to Sir Humphrey Davy, who remarks that the dreadful accidents of explosions are occasioned by the firing of light carburetted inflammable gas, which is disengaged during the working of the coals, and from fissures in the strata; and which, when it has accumulated so as to form more than 1-13th part of the volume of the atmospherical air, becomes explosive by a lighted candle,

or by any kind of flame. The apertures in the gauze should not be more than 1-20th of an inch square. As the fire damp is not inflamed by ignited wire, thickness of the wire is not of importance, but wire from 1-40th to 1-60th of an inch in diameter is the most convenient. If the wire of 1-40th is found to wear out too soon in practice, the thickness may be increased to any extent; but the thicker the wire, the more the light will be intercepted, for the size of the apertures must never be more than 1-20th of an inch square. In the working models which he has sent to the mines, there are 748 apertures in the square inch.

When the wire-gauze-safe-lamp is lighted and introduced into an atmosphere gradually mixed with fire-damp, the first effect of the fire-damp is to increase the length and size of the flame. When the inflammable gas forms as much as 1-12th of the volume of the air, the cylinder becomes filled with a feeble blue flame, but the flame of the wick appears burning brightly within the blue flame, and the light of the wick continues till the fire-damp increases to 1-6th or 1-5th, when it is lost in the flame of the fire-damp, which in this case fills the cylinder with a pretty strong light. As long as any explosive mixture of gas exists in contact with the lamp, so long it will give light, and when it is extinguished, which happens when the foul air constitutes as much as 1-3d of the volume of the atmosphere, the air is no longer proper for respiration. In cases in which the fire-damp is [illegible] proportion with air, the use of the wire-gauze-safe-lamp, which rapidly [illegible]sumes the inflammable gas, will soon reduce the quantity below the explosive point; and it can scarcely even happen, that a lamp will be exposed to an explosive mixture containing the largest proportion of fire-damp: but even in this case the instrument is absolutely safe; and should the wires become red hot, they have no power of communicating explosion. Should it ever be necessary for the miner to work for a great length of time in an explosive atmosphere, by the wire-gauze-safe-lamp, it may be proper to cool the lamp occasionally by throwing water upon the top, or a little cistern for holding water may be attached to the top, the evaporation of which will prevent the heat from becoming excessive.

THE GAS-LIGHT APPARATUS.

This apparatus consists of an iron retort, about 3 feet long, and two feet in diameter, open at one of its extremities, to which is screwed, by means of a flaunch, a door piece: to this the door is applied, and is shut close by a screw placed in the centre. The coals to produce the gas are shut up in the retort, and the whole heated to redness by a fire applied underneath, the retort being placed in a sort of oven or furnace, so that the heat surrounds every part, except that at which the coals are introduced. Around the space of this oven a flue leads from it to the chimney, the aperture of which is regulated by a small damper. A plate of cast iron preserves the retort from being injured by the intensity of the fire underneath it, and causes it to be heated more uniformly. A cast iron pipe conveys all the volatile products of the coal to a refrigeratory of cast iron, in which the tar, &c. extracted from the coal are deposited, and whence they can be drawn off by means of a copper pipe. The gas is conveyed from the refrigeratory to the top of a cylindrical vessel or receiver, which is in that part air tight: consequently the gas displaces the water in this receiver, to a level with the small holes made round its inferior edges, where it is suffered to escape, and rises in bubbles, through the water of the well, into the receptacle or gasometer.

This gasometer is made of wrought iron, and is capable of rising, or of sinking down nearly to a level with the top of the well which contains the water, when it will consequently be nearly filled with that fluid; but it rises gradually as the elastic gas enters it from the pipe, and displaces the water. Weights are suspended to balance and keep it steady: it is strengthened withinside by two sets of iron stays; its seams are luted to make them air tight; and it is well painted inside and outside to preserve it from rust.

The use of the gasometer is to equalize the emission of the gas, which issues from the retort more quickly at some times than at others. When this happens, the vessel rises up to receive it; and when the stream from the retort diminishes, the weight of the gasometer expels its contents, the balance weight not being quite so heavy as the gasome-

ter, in order that a suitable pressure may be exerted to force the gas out at the burners with a proper jet.

The gas, after it leaves the deposit vessel, and before it reaches the gasometer, is passed through a vessel of lime-water, to deprive it of every bituminous and sulphureous smell. From the gasometer it enters a tube by small holes made at its top, and, passing on through other tubes, is conveyed by pipes to the burners, or lamps, where it is to be consumed. These burners are formed in various ways, either by a tube ending with a simple orifice, at which the gas issues in a stream, and, if once lighted, continues to burn with a steady and regular light as long as any gas is supplied. At other times a number of very minute holes are made in the end of a pipe, which form as many *jets de feu*, and have a very brilliant appearance. If the gasometer of a gas-light aparatus has a diameter of five feet by seven feet high, it will contain a sufficient quantity of gas, at four cubic feet per light, per hour, to give forty hours light to a brilliant Argand lamp, or five hours to eight lamps, equal in intensity to one hundred and sixty common street oil lamps. Such a gasometer will be filled by the distillation in the retort of about half a bushel, or a quarter of a hundred weight, of coals. The remains which are found in the retort, after the process is finished, consist of most excellent coke, which in value, for culinary fires, or manufactories, returns a considerable portion of the whole expences.

The experiments made by Mr. Brande, in a small gas apparatus erected in the laboratory of the Royal Institution, lead to the conclusion, that a chaldron of good Wallsend Newcastle coals would afford from 17,000 to 20,000 cubic feet of gas; but the process of distillation, as it has been carried on in the large establishments for lighting the metropolis, has seldom afforded a larger average produce than 12,000 cubic feet. There can, however, be little doubt that, by improvements in the construction and management of the retorts, the highest of the above averages may be obtained. In the month of April, 1816, at the three stations belonging to the chartered Gas-light Company, situated in Peter-street, Westminster, in Worship-street, and in Norton-Fulgate, twenty-five chaldrons of coals were daily carbonized, actually yielding 300,000 cubical feet of gas, equal to

the supply of 75,000 Argand's lamps, each lamp giving the light of six wax-candles. If the full proportion of gas had been obtained, namely, 20,000 cubic feet from each chaldron of coals, the produce would then have been 500,000 cubic feet, equal to the supply of 125,000 lamps of the same size; and the light then afforded would have equalled that of 750,000 wax-candles, instead of 450,000, which was the real produce. Including that of the City Gas-works, in Dorset street, Blackfriars Bridge, the total daily consumption of coals in London, for the purpose of illumination, then amounted to 28 chaldrons, and the number of lights supplied to 76,500; but this amount has been since greatly augmented, and this invaluable discovery, which now bestows an additional lustre on our theatres, &c. &c. is rapidly communicating its benefits to every part of the United Kingdom.

LONDON WATER-WORKS.

Among works of great magnitude, and displaying a vast ingenuity in their contrivance, may be cited those of the various companies for supplying the metropolis with water, the modes of forcing which into the main pipes, at the heads of the respective establishments, and thence conveying it, by subordinate pipes, through the different streets, so as to afford an ample supply to the inhabitants, as well as to provide against fires, may be reckoned among the most useful of the wonders of art.

The new river works at Islington claim the earliest notice, as having supplied the capital with pure water for nearly two centuries, at an original cost to Sir Hugh Middleton of £500,000. The reservoir is eighty-five feet above the level of the Thames; but, to give it the necessary force, it is raised thirty-five feet above that level, whence it rises into the second and third stories of most houses. The quantity it discharges every twenty-four hours is 214,000 hogsheads of sixty-three gallons each. There are besides, the London-bridge water-works, in which a forcing engine serves the purpose of a high level, but the water is not strained nor purified; the York-buildings works; the East London works; the South London; the West Middlesex, at Hammersmith and Kensington, on a grand scale, with contrivances for purifying the water; and the

GRAND JUNCTION WORKS, at Paddington. Iron pipes have been latterly substituted for wooden ones; and the general arrangements for the distribution of the water, are such as far surpass those of any similar establishments in the different capitals of Europe.

THE DIVING-BELL.

THIS invention, by the means of which an operator descends to any depth of water, and remains there for several hours, is founded on the elasticity of the air. Weights are placed at the bottom to prevent it from turning; and a forcing pipe sends in fresh air, to supply the waste of vital air from the respiration of the operator.

The sinking and raising of the diving-bell, invented by Dr. Halley, depending entirely on the people at the surface of the water, and being besides of considerable weight, so as to occasion much labour, with a risk of the breaking of the rope by which it was to be raised, to the sure destruction of those within, a diving-bell has been invented by Mr. Spalding, of Edinburgh, to remedy these defects, and prevent the edges of the machine from being entangled by any ragged prominences of rock. His machine is of wood, suspended by ropes, and having leaden weights appended to it, by which the mouth of the bell is kept always parallel to the surface of the water, whether the machine, taken altogether, is lighter or heavier than an equal bulk of water. By these weights alone, however, the bell would not sink; another is therefore added, which can be lowered or raised at pleasure, by means of a rope passing over a pulley, and fastened to one of the sides of the bell. As the bell descends, this weight called by Mr. Spalding the balance-weight, hangs down a considerable way below the mouth of the bell. In case the edge of the bell is caught by any obstacle, the balance-weight is immediately lowered down, so that it may rest upon the bottom. By this means the bell is lightened, so that all danger of oversetting is removed; for being lighter, without the balance-weight, than an equal bulk of water, it is evident that the bell will rise as far as the length of the rope affixed to the balance-weight will allow it. This weight, therefore, serves as a kind of anchor to keep the bell at any particular depth which the

divers may think necessary; or, by pulling it quite up, the descent may be continued to the very bottom.

By another very ingenious contrivance, Mr. Spalding has rendered it possible for the divers to raise the bell, with all the weight appending to it, even to the surface of the water, or to stop it at any particular depth, as they think proper; and thus they would still be safe, even though the rope designed for pulling up the bell should be broken. For this purpose the bell is divided into two cavities, both made as tight as possible. Just above the second bottom are small slits in the sides of the bell, through which the water, entering as the bell descends, displaces the air originally contained in its cavity, which flies out at the upper orifice of a cock expressly fitted for that purpose. When this is done, the divers turn the handle which stops the cock; so that if any more air were to get into the cavity, it could no longer be discharged through the orifice as before. If, therefore, the divers wish to raise themselves, they turn the cock, by which a communication is made between the upper and under cavities of the bell. The consequence is, that a quantity of air immediately enters the upper cavity, forces out a quantity of the water contained in it, and thus renders the bell lighter by the whole weight of the water which is displaced. Thus, if a certain quantity of air is admitted into the upper cavity, the bell will descend very slowly; if a greater quantity, it will neither ascend nor descend; but remain stationary; and, if a larger quantity of air be still admitted it will rise to the top. It should be observed, however, that the air which is thus let out into the upper cavity, must immediately be replaced from the air-barrel; and the air is to be let out very slowly, or the bell will rise to the top with so great a velocity, that the divers will be in danger of being shaken out of their seats. But by following these directions, every possible accident may be prevented, and persons may descend to very great depths without the smallest apprehensions of danger. The bell also becomes so easily manageable in the water, that it may be conducted from one place to another, by a small boat, with the greatest ease, and with perfect safety to those within.

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NOTE.—*The reader of this Volume will perceive that it is mispaged in several instances. It is in accordance with the London Copy—The errors were not discovered until the table of contents, &c. were struck off. It was then too late to correct.*

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